THE PHARMACIST AT WORK

BY

WILLIAM C. ALPERS

PHILADELPHIA
J. B. LIPPINCOTT COMPANY
1898

PREFACE.

Part of this work first appeared as a series of articles in "Merck's Report" of 1895 and 1896. Numerous favorable comments on these papers and the expressed wish of many readers to have them presented in book-form induced me to rearrange and complete them so as to include all the official pharmaceutical preparations. I here render my thanks to the editor and publishers of "Merck's Report," for their consent to have these essays—even though in altered and enlarged form—reproduced in this volume.

In offering this book to my pharmaceutical brethren, I trust that its performance may be measured by its plan. There is no intention to present a complete or systematically grouped delineation of the science or art of pharmacy; nor is the book expected to replace or supersede any other existing work. Its main object is to depict, through the means of examples drawn from actual occurrence, the necessity of combining *theoretical knowledge* with *practical experience* in order to meet the many emergencies of our profession; further, to place before the older pharmacists a model of how they may effectively instruct their apprentices, and, finally, to teach the younger ones how to learn and study, and how to apply book-learning to their daily work.

The volume therefore commends itself to all those young men who, by force of circumstances, are deprived of the benefits of college education, and must work their way through the intricacies of the various branches of pharmacy by home study. It will show them how to understand books of learning, and create in them the desire to know more than the mere names or doses of the drugs and chemicals which they handle every day. It will teach them that there is nothing so small and insignificant in pharmacy that its source and history may not be profitably made the subject of research, and will give them the first glimpse—even if only a cursory one—into the unimagined beauties and treasures of scientific knowledge.

The student who, after preliminary instruction, completes his education in a pharmaceutical college before entering on actual work may, with equal advantage, use this book. It will assist him in many practical difficulties, and show him how to utilize theoretical knowledge. He will soon cease to look upon his merely practically taught brother with pity or derision, and he will be brought to the admission that the technical skill and deftness peculiarly requisite in pharmacy are accomplishments that must be learned by experience behind the counter.

Not only the young pharmacists, however, but possibly also my older brethren, may profit by reading these pages. Not that I pretend to be able to teach them anything *new:* there is nothing in this book that every pharmacist should not know; indeed, all that is written therein has actually happened, and may happen again, in the daily routine of many pharmacists. But efficiently to impart knowledge and enthusiasm to their apprentices and clerks; to teach them not only to become skilful pharmacists, but also to love their profession,—this is a gift that not all possess, and which but few practise. Let this book find opportunity to be a guide for such proprietors, and let its true story imbue them with faith in the great pleasure and satisfaction which is to be derived from patiently instructing the rising generation, and thus preparing them to become, in *their* day, more efficient, more faithful, and more advanced pharmacists than *we* are.

At the same time, if I should succeed in showing the reader that, in spite of all common drudgery and serious difficulties, the profession of pharmacy has its desirable features, and can be practised with attachment and devotion,—if I should be able to arouse in my *confrères* that *love* for their daily task which alone can compensate for the many privations we must suffer, and which is also the surest road to success,—I will feel amply rewarded.

THE AUTHOR.

CONTENTS.

THE

PHARMACIST AT WORK.

CHAPTER I.

THE LABORATORY—POWDERING DRUGS—COMPOUND LIQUORICE POWDER—SIEVES.

"THIS is hard work," said the Junior to the Proprietor, wiping the perspiration from his forehead; "I did not think that it would be so tedious to powder camphor."

"If you had had some experience in powdering drugs," replied the Proprietor, "you would have finished your work in less time and with less labor. In the beginning, you put too much alcohol in the mortar, so that the mixture was too moist and could not be powdered; you then added too much camphor, and continued to make these mistakes for half an hour. In powdering drugs, you must never take more than a small quantity at a time; for the first powdered lot will act like an elastic layer around or under the coarser parts and protect them against the action of the pestle, and if, then, you use more power, you drive the finer particles off into the air. I did not wish to interfere; for I thought that, coming from a well-known pharmacy, where you spent two years, you were familiar with the nature of camphor."

"I must confess," said the young man, who had been engaged by this Proprietor only a few days before, "that this is my first attempt at powdering camphor or any other drug."

The room where this conversation took place was a spacious laboratory, connected with the pharmacy by a sliding door, which usually stood open, so that the Proprietor as well as his assistants could easily step from one room to the other. The morning hours, when business was comparatively dull, were mostly employed in making some galenical preparation; and the Proprietor always instructed the younger clerks in such laboratory work,—watching each step of the process,—explaining and commenting, showing, whenever necessary, how to handle pestle and graduate, and himself preparing only such things as required the skill of a more experienced hand.

"You said you never powdered camphor formerly," continued the Proprietor. "Who, then, did such work, if not the junior clerks?"

"Nobody; we bought it powdered, like everything else."

"Did you not make your own fluid extracts and tinctures?"

"No, sir; everything came into the store ready-made. In fact, we had no place to make preparations; there was hardly room enough behind the prescription-counter to turn around; and our chief business was the sale of soda water and toilet articles. And, indeed," he added, hesitatingly, "could not every pharmacy be conducted without a laboratory just as well?"

"Decidedly not!" said the Proprietor, emphatically. "A variety bazaar can be established and conducted in that way, but not a pharmacy."

The Junior did not contradict, but his doubtful eyes betrayed his mind.

The Proprietor read his thoughts; and, wishing that all his employees should share his own views on the profession which he cherished highest of all earthly goods, he at once embraced the opportunity to enlighten the young man and lead him towards the right way.

"Tell me," he said, "have you not learned more about camphor during the last hour than you ever knew before?"

"Well—yes," was the reply; "I certainly learned a good deal. But, on the other hand, what is saved by powdering it here in the laboratory?—does the small saving pay for the time and labor?"

The Proprietor answered: "The saving is really the smallest of the advantages of the laboratory, although it is in some cases not inconsiderable. The principal advantage is the purity of the preparations thus attainable and the positive knowledge of their purity and exactness. Here, for instance, we used half an ounce of magnesium carbonate to the pound of camphor, or about three per cent. Now, in the commercial powdered camphor a much larger percentage of magnesia is sometimes added; and how great is the temptation to do so, when camphor costs four times as much as magnesia! Some time ago, in controversy with a friend on this subject, I ordered a pound of powdered camphor from a wholesale house in good repute, and separated the camphor from the adulterant by dissolving it in alcohol and filtering the undissolved magnesia off. After drying and weighing the residue, I found as much as thirty-five per cent. of magnesia. Could any one after such a discovery continue to buy powdered camphor and remain an honest dispenser and careful pharmacist?"

The Junior had meanwhile cleaned mortar and pestle by using a few cubic centimetres of alcohol; but the Proprietor, growing warm on his subject, continued: "The laboratory is my favorite abode; here I spend the happiest hours of my business life; what I see around me is my own, not only because I paid for it, but because most of these preparations are the result of my experience, my ability, my labor. In stating the composition of this tincture or the strength of that fluid extract, I do not repeat the assertions of some travelling salesman or simply read off the printed labels of some manufacturer. No! I give a record of my own work, my care, my patience and perseverance. The contents of these packages and bottles are dear to me, because I created them; they tell the history of my daily life, and their perfection is a testimonial to my knowledge of and my devotion to my profession. And as we always learn by teaching, so do we also increase our skill and knowledge by using them in compounding our own preparations. The properties of drugs become known to us, not through inert statements of books, but, as it were, through living voices, that speak to us and tell us their origin, their history, their use and application. Thus, the laboratory gives us a continuous schooling towards our own perfection, more eloquent than learned professors, plainer and clearer than the most powerful language. It teaches us to discern the pure from the adulterated, the good from the bad, and trains us to reach the highest degree of care and exactness so necessary in the discharge of our duties."

After a pause, he continued: "How manifold are the reflections that occur to the thinking workers in the laboratory! In handling the various drugs he travels on the wings of the mind from land to land; he crosses oceans and mountains; he picks a shrub from the rocks of the Andes and in the next minute wanders through the plains of Persia; he descends into the depths of the earth for glistening minerals, and rises to the tops of snow-crowned peaks to hunt for lichens and mosses. There is no barrier, no limit. And all this is not the idle fancy of an overstrung brain, but the systematic journey of a reasoning mind, asking each drug its origin and home. Tell me, my young friend, what thoughts had you while you powdered the camphor?"

The Junior blushed and found no answer. The enthusiasm of his employer was to him a phenomenon so unexpected, so sudden, and so entirely different from anything that he had been accustomed to meet in pharmacy, that these words appeared to him like a revelation; he was unable to entirely follow the old man before him, who, with his sparkling eyes and impressive speech, seemed to be much younger than before. But he suddenly became conscious of a beauty and grandeur in his profession which before he had never been aware of.

"I do not know——" he stammered.

"Let me tell you," interrupted the Proprietor, "what I was thinking of when, years ago, I had to powder camphor myself. First, my thoughts carried me to Asia, the home of camphor. I now again imagine myself there. From China I cross to Japan, and farther south to the island of Formosa, the richest ground of the camphor-tree. I enter the virgin forests where this evergreen tree abounds. Its growth reminds me of the linden, with a thick, straight trunk, branching above manifold, covered with a smooth, greenish bark. The small, white, clustered flowers exhale the odor of camphor; some have already formed the fruit,—a red berry. I admire the magnificent foliage of smoothribbed, lanceolate leaves, bright green above and paler below. I watch the natives chip the tree and gather the leaves. They heat them in a roughly-constructed still, after having covered them with water. The steam that rises carries with it the sublimed camphor, which is deposited in crude earthen vessels. The camphor is then shipped in baskets to the trading-places; and I see before me, in Canton, representatives of all civilized nations bargaining with the wily Mongols for this valuable product. The ship is laden; I go aboard; anchor is weighed; we sail south, touching at Batavia, where another quantity is added to the cargo,—called Dutch camphor, after the people who control its market. It is, like the former, in granular masses, but of a pinkish color, and valued higher because it is purer. Now we sail home; the crude camphor is brought to New York and Philadelphia, where it is purified in extensive refineries, and finally comes into the market in large, circular plates of one or two inches' thickness. All this appears to me while I inhale the aromatic vapor. But my thoughts not only travel back, but also forward. From my store I follow the camphor into the houses of my customers. I see some of it put into boxes and trunks to keep moths from attacking valuable furs and clothes; some dissolved in alcohol, to form camphor spirit and other liniments for the lame and sick; and some of it, the powdered, reaches the mournful chamber of the unfortunate who is stricken with pneumonia. My imagination sees the nurse prepare the poultice of which camphor is an important ingredient; and, by the proper use and correct strength of this powder, a human life may be saved. And, knowing this, can you be careless and indifferent as to the degree of its purity? Is it mere sentimentality to think of this, or is it the consciousness of your responsibility that directs your thoughts? And, thus thinking, the work progresses without effort, and you are surprised that, by the time your thoughts return home, the powdered camphor is before you."

After a while the Junior broke the silence, saying:

"That is certainly a beautiful way to work, but not every one can do it. How many are there that know all this about every drug?"

"Is not this your guide?" replied the Proprietor, pointing to a dispensatory that lay on the table. "If you know nothing about a drug, should not the task of handling it fill you with the desire to learn something about it? Open the book while you powder the drug and let your eyes run over the lines, or, if your full attention is required in the work, read up the subject soon afterwards. What you read and learn on such occasions will remain your own for all your life."

"I am sincerely thankful," said the Junior, "and will try to follow your instructions."

"Why did you not put all the camphor into the stock-bottle?" asked the Proprietor, pointing to a small paper in which was some of the powder.

"When I cleaned the prescription-counter this morning," said the Junior, "I noticed that the bottle labelled 'Camphor' did not contain any powder, but small pieces of camphor, and I thought I could take them out and replace them by some of this powdered camphor."

The Proprietor smiled and said: "I am glad to see that you observe; it is one of the most necessary qualifications of a pharmacist to see not only with his eyes but also with his understanding, as you have done in this instance. However, in this case, you nevertheless went wrong, for, as you know, our powdered camphor contains three per cent. of magnesia, is therefore not pure, and should not be used for prescription work."

"It was always done thus in my former position," interposed the Junior.

"Now you see," said the Proprietor, "to what careless practices the indiscriminate buying of ready-made goods will lead. The commercial powdered camphor sometimes contains, as I have shown, as much as thirty-five per cent. of adulterants, and may contain more. If we should use it in prescriptions the patient would get only two-thirds of the amount of camphor that the physician prescribed. As a consequence, the medicine would not have the expected effect, and physician and patient would gradually lose their confidence in the pharmacist. Moreover, consider the moral wrong involved in giving the confiding customer inferior or ineffective medicine."

After the Junior had replaced the small particles of camphor into the bottle, his eye caught the various pharmaceutical apparatus that stood along the opposite walls of the laboratory, among which there were two drug-mills, one small one for hand-power and a large one driven by an electric motor.

"Why could we not have powdered the camphor in the mill?" he asked.

"On account of its tendency to clog; instead of running through the mill as fine powder it would have clogged the grinding wheels. This is often, although in a smaller degree, the case with other drugs,—especially when they are moist,—and it takes some experience to handle the mill properly. Often a drug has to be ground repeatedly, setting the mill finer every time. In using the same mill for various drugs great care should be taken to clean each part of the mill after each operation, so that small particles of one drug are not mixed with the next one."

"Compound liquorice powder must be made!" shouted the Senior clerk, coming through the door from the store. "I just sold a pound, and the stock-bottle is nearly empty." Going through the laboratory he looked into several jars and cans, and, handing the Junior a slip of paper, he added, "Here is a formula: 'Senna (No. 80), 180; liquorice (No. 80), 236; washed sulphur, 80; oil of fennel, 4; sugar, 500 grammes.' You had better make five kilos. But our sugar is almost out, and we shall not get another barrel before night. Here, boy," he said, addressing a lad who was washing bottles at a sink in a corner of the laboratory, "run and get some powdered sugar."

"How much shall I get?" asked the boy.

"Let me see; about five or six pounds."

"How much?"

"About five or six pounds; can't you hear?"

The boy hesitated a second and looked inquiringly at the Proprietor, who said, in a quiet but decided way, "Get six pounds."

While the Senior returned to the store, the Proprietor addressed the Junior: "Now, remember what I told you; and, when you mix the ingredients, try to think of the nature of the drugs that you handle, and your work will be much easier."

"Will you not show me how to incorporate the oil with the powder?"

"I will return directly," said the Proprietor; "meanwhile weigh out the different ingredients, taking five times the quantities marked on that slip."

With these words he followed the Senior into the store. After ascertaining that no customer was present who might hear him, he said: "You made a mistake in giving the quantities."

"I beg your pardon, sir," interrupted the Senior, somewhat excitedly, with the air of authority that college students are apt to assume when they approach their final examination. "I looked the formula up in the 'Pharmacopœia,' and I know that it is correct."

"You made another mistake just now," replied the Proprietor, quietly.

The Senior looked at him in surprise.

"Will you kindly tell me what you mean?" His voice sounded less assured than before.

"Your second mistake consisted in interrupting me and refuting a charge that I had not made," said the Proprietor; and after a short silence he added: "And your first mistake was the order for sugar that you gave the boy. Instead of ordering a definite quantity, you said 'five or six pounds,' leaving it to him to decide what to do."

"But it was really of no account. I believe five pounds would have been enough; for, adding what little we have left, we would have had two and a half kilos, and some to spare."

"It was of no account as far as the sugar was concerned; but of great account as far as the boy's estimate of your ability is concerned. A man in our profession must not be vague and undecided, or he will never gain public confidence. Have you never been provoked by the customer who asks for 'Glycerin,—about ten or twenty cents' worth'? If you give him ten cents' worth, he will say, 'That is too little; put some more in;' and if you give him twenty cents' worth, he will say, 'That is too much; I guess half of it will do.' And yet you practise his faults yourself. If a mother asks you how much syrup of rhubarb she shall give her child, you may say, 'Oh, about a teaspoonful, or half a one; it does not matter.' You may be right in respect to the dose, but you are greatly wrong in respect to your reputation. That mother thinks of nothing at the time but her child's health, and when she comes home and tries to give the child the rhubarb, the vagueness of your answer at once comes to her consciousness so powerfully that she will be likely never to ask you another question nor to buy another ounce of syrup of rhubarb from you. Let there never be a doubt about the meaning of your words; such looseness is bad in every position, but especially so with a physician or pharmacist. The sick and afflicted look for a decided voice and firm hand to guide them; do not disappoint them by indecision."

The boy now returned with the sugar and handed it to the Junior, who had meanwhile weighed the liquorice, senna, and sulphur, and presently also weighed the sugar. The Proprietor, stepping back into the laboratory, directed the Junior to put some of the sugar into the large porcelain mortar, and then to add the oil of fennel, drop by drop, constantly stirring. While this was being done, he said:

"Whenever it is required to incorporate a volatile oil with a mixture of powders, you must first mix the oil with the powder of the greatest absorptivity; in this case the sugar. Should you, for instance, mix the oil with the sulphur, the friction of the pestle would, indeed, divide it very finely; but the small particles of the oil would not be absorbed by the sulphur, and would consequently be driven off into the air by evaporation; the whole laboratory would strongly smell of fennel, and the inexperienced clerk would say, 'Ah! that is a strong preparation; how it smells of fennel!' whereas, in reality, a large quantity of the fennel would be lost. We now add the remaining sugar and the other ingredients, and continue to stir until a uniformly one-colored powder is obtained."

"Shall I now fill this powder into the stock-bottle?" asked the Junior after a while.

"Not yet. Sieve it through a No. 60 sieve before storing it."

The Junior went to the side of the laboratory, where he saw a number of sieves hanging in a row; but, being entirely unacquainted with the various implements, could not decide which one to take. The Proprietor came to his assistance and explained: "A No. 60 sieve is one that has sixty meshes to the linear inch. You see here is a No. 20, a rather coarse one; this is No. 40 and this 60. The figures on the side of the frame are almost obliterated; but every pharmacist of some experience can tell the different sizes without looking at the label or counting the meshes."

The Junior took the sieve and used it. "I should think," he said, "that if the powders are all pure and of the proper grade, sieving again would not be necessary."

"Theoretically, you are right," replied the Proprietor; "but practice teaches us that this additional care is necessary. In the first place, there sometimes remain, in spite of the greatest care and continuous stirring, small lumps of some powder,—for instance, sulphur,—which will be detected on the sieve; and, secondly, when bought ready powdered (which you sometimes can't help doing), these powders may contain particles of the plant from which they come, or splinters of wood from the barrels in which they were shipped, or other accidental contaminations. All these must be removed. Now, after finishing the powder and cleaning the sieve, spend half an hour in reading about senna, liquorice, fennel, and sulphur, and you will have not only learned how to make compound liquorice powder, but also acquired a considerable amount of theoretical knowledge."

CHAPTER II.

PRESCRIPTIONS IN POWDER FORM—CRITICISM OF PRESCRIPTIONS—CONFIDENCE IN PHARMACEUTICAL WORK—DELIQUESCENCE AND EFFLORESCENCE PRESCRIPTION SIEVE—OFFICIAL POWDERS.

WHEN the Proprietor returned to the store he found an elder assistant of his, who acted as manager during the owner's absence, engaged in preparing a prescription, and the Senior, in a mild state of excitement, arguing with him. Seeing the Proprietor, the Senior addressed him at once, showing him the prescription in question.

"Will you kindly decide, sir, if I am wrong? I claim that the fine powder should be used in this case."

The Proprietor took the prescription and read:

℞ Potass. Nitr., 1;
Fol. Stramonii, 90;
Fol. Digitalis, 5.
M. et ft. pulv. No. 1.
Sig.—"Burn and inhale, or smoke in a pipe."

The Proprietor looked at the Senior and asked, "Did you ever smoke snuff?"

This question confused the Senior, and he at once saw his mistake; but, not wishing to acknowledge it, he replied: "Would the fine powder not burn much quicker?"

"Perhaps it would; but the object of the prescription is not to prepare a quickly burning powder, but to enable an asthmatic patient to inhale as much as possible of the smoke. How did you prepare it?" he asked the Manager.

"I first rubbed a little more than ninety grammes of stramonium leaves between my hands over a piece of paper, breaking and crushing them gently. Then I removed the unbroken ribs, and broke again the larger pieces of the leaves. After weighing ninety grammes of the very coarse powder, I put it aside, throwing away the little that was left. The same operation I performed with the digitalis, weighing five grammes of it, and adding it to the stramonium. The saltpetre I powdered separately in a porcelain mortar, and sprinkled it on the broken leaves. Then I mixed it all carefully by my fingers and put it into a box. Here it is."

The Senior, being inflated by a feeling of infallibility, was badly grieved that he should be wrong, and looked around for an object on which to unload his anger and disappointment. His eyes fell on the prescription, the innocent cause of the trouble, and, pointing to the third item on it, he said, somewhat sneeringly: "I'd like to know what digitalis leaves have to do in this combination. Who ever heard that they will relieve asthma? We might just as well have left them out."

The Proprietor replied: "Aside from the fact that there may be many things that you do not know yet, I would remind you that a pharmacist's examination of physicians' prescriptions should never go further than to ascertain if the limit of safety has been exceeded, or if there be some chemical incompatibility. In that case we confer with the doctor. All other criticism on our part is wrong, and even harmful. The presence of digitalis in this powder is not injurious; and the thought that the physician has ordered something useless should not enter your mind."

"But suppose," retorted the Senior, who was bound to gain at least one small point in this controversy, "that the customer should ask what digitalis leaves are for; would you not tell him that they were useless?"

"How do you know that they are? The physician knows his patient, and also the prescribed drugs; and if his judgment and experience make him order foxglove in this combination, all doubt or dispute from the pharmacist's side should be at rest. Medical conventions or journals are the places to argue such questions, but not a pharmaceutical laboratory. But even admitting that they were useless, what can I gain by telling the patient so, and thereby shaking his confidence in his physician? He either believes me, and I have made the physician my enemy, or he does not believe me, and hence will consider me an idle talker and prater, and take his patronage to some pharmacist of more common sense. The maxim, 'Mind your own business,' cannot be too often impressed on young pharmacists, who are often ready to neglect their own and manage—or, rather, mismanage—the physician's business."

The Senior was cut short in his next attempted reply by a customer who entered the store at this moment. It was a rule in this pharmacy never to allow any controversy, or even friendly argument, in the presence of a customer, lest the latter might misunderstand its meaning, and imbibe the idea that there existed some doubt on a prescription or other important matter. If any explanations had to be given, they were made in the laboratory, away from the hearing of outsiders.

"Is the doctor in?" asked the customer of the Senior, who had gone to wait on him. By this title, so familiar to most pharmacists, the Proprietor was called by many customers.

"Yes, sir," replied the Senior, grumblingly. "What do you want of him?"

"I have here two prescriptions——"

"Well, I can put them up," said the Senior.

"That may be," replied the customer; "but I would rather have them prepared by the doctor himself."

The Proprietor, overhearing the conversation, stepped forward, and, after exchanging a few friendly words with the customer, took the prescription and invited him to take a seat.

"I have another errand," said the customer, "and will be back in about an hour."

The Senior's bad humor was far from being subdued by this disregard of his importance, and, although he refrained from expressing his feelings, his wrinkled forehead and sour features betrayed them openly.

"You should not feel offended at the customer's words," said the Proprietor. "He did not doubt your ability at all, but preferred to intrust the work to a man whom he has known for many years."

"Yes, that is all right," grumbled the Senior; "but it certainly is not pleasant to be treated in this way after having spent two years in college, studying from morning till night."

"You will see that something more than college education is required to make a successful pharmacist. In the first place, experience, and, secondly, the confidence and esteem of your fellow-men. How to gain these cannot be taught in a college; such qualities are an art, an accomplishment, an ability, or whatever you may call it, that can be practised alike by the most ignorant and by the most learned; they are the result of your individual thoughts, words, and actions. Like a seed, capable of producing the most wonderful fruit, the possibility of practising this art is given to every human being with his birth. He may either develop or crush it. Truly, the soil on which the seed falls will either retard or quicken its growth. The surroundings at home, the influence of loving parents and devoted teachers,—or, on the other hand, the atmosphere of hatred and vice,—have much to do with its first germination; but the main cultivation of this plant is its possessor himself. Happy is he, no matter in what sphere he lives, who recognizes its importance in early years. In the heartless struggles of practical life, in the strife for recognition, it is a powerful ally; in the time of calamity, when your mind is depressed and dark despair hovers at your door, it comforts and raises you like a loving friend; in the triumphant hour of success it is the crowning laurel of your reward. So far you have had little time and opportunity to think of this; for some years you have worked faithfully in your profession. The goal before you was the diploma of your college; for this you strove and worked. And it is right that you value it highly, that you consider it a prize worthy of your best efforts, to be gained not by chance or luck, but by your own energy and mental perseverance. But what you did so far was only the fulfilment of a strictly defined duty; others laid out the road that you travelled. Soon a different state will exist for you; you will then assume your own responsibility, depend on your own resources; and at once it will become apparent to you that the time to observe, to learn, to acquire ability, is far from being past, and that something of greater importance and weight than mere knowledge must be gained. Life is often compared to a ship. Call, then, the professional education the 'sail.' Its size and strength will command admiration. But more than a flowing sail is wanted to win the race. The confidence and esteem of your fellow men, indispensable especially in our profession, is the ship's 'rudder;' and the sail and rudder both must be guided by the firm hand of experience. The rough but experienced boatsman who, in an emergency, constructs a crude sail, perhaps out of a torn garment, will often outsail the elegant boat with the most approved sailing apparatus, but without proper guidance. So the steady, industrious business man, without much education, will surpass the most refined graduate who lacks moral strength. We meet them every day, such misguided unfortunates, wrecked, homeless, penniless. But let us go to our work."

He put the two prescriptions that he held in his hand on the counter, and allowed the clerks, whom the Junior had by this time joined, to read them.

The first was:

℞ Morph. Sulph., gr. ii;
Pepsin. Pur., ℥ss;
Pancreat. Pur., ℥ss;
Bism. Subnit., ℥iii.
M et divid. in chart. No. xii.
Sig.—"One powder every three hours."

The other was:

℞ Caffeinæ, gr. xxx;
Kali Acet.,
Kali Citr., āā ℥iii.
M. et. div. in chart. No. xii.
Sig.—"One powder, as directed."

"How would you prepare them?" he asked the Senior.

"I see no difficulties there," was the reply. "Weigh the ingredients, mix them, and divide them into powders."

"Are no special precautions necessary?"

The Senior pondered awhile, and said:

"Of course, you want to triturate the morphine carefully with the other ingredients, so as to distribute it well. In putting up the individual powders, each should be weighed separately, on account of the strongly active ingredient,—morphine."

"Your suggestions are right as to the first prescription, which needs thorough and long trituration," said the Proprietor; "but the second one needs different treatment. The acetate and citrate of potassium are both very deliquescent salts,—that is, they easily attract moisture from the air, and the more so in the powdered state: hence they will, on lively trituration, form a moist magma. Care should, therefore, be taken to have them both perfectly dry before powdering; then cautiously powder them separately; add the caffeine to the acetate, and triturate again very carefully until all the fleecy, flexible crystals of the former have been well broken; and, finally, add the citrate, and mix with a horn spatula for a long while, avoiding pressure. When finished, the powders of this prescription should be wrapped in waxed paper."

"Ah! I see," exclaimed the Senior, approvingly;

"that is the same thing as mixing lead acetate and zinc sulphate. We had that in our quiz last night; they also form a moist powder."

The Proprietor smiled, and said: "It is the same in both cases, as far as the moisture is concerned; but the causes are quite different. In your example there is no deliquescence, both chemicals being rather efflorescent,—that means they lose some of their water of crystallization on exposure to the air. But in triturating them energetically a chemical decomposition takes place, the two bases mutually exchanging their respective acids, and thereby liberating some of their water of crystallization, in which the zinc sulphate is particularly rich."

"Why do we wrap the powder of this prescription in waxed paper?" asked the Senior.

"In order to exclude the air, which always contains more or less water, and prevent deliquescence. The waxed paper is impervious to moisture and will preserve their contents longer than ordinary paper. The name 'waxed paper' is, however, improper. Formerly paper was dipped in melted beeswax and thereby made water-proof; but this method has long been abandoned, paraffin having taken the place of wax. The paper thus prepared is more durable than the old-fashioned waxed paper; it will assume no odor on keeping and has more resistant power towards various chemicals, besides being of better appearance. Another paper much used for similar purposes is parchment-paper, so called from its resemblance to parchment. It is made by treating unsized paper with a mixture of sulphuric acid and water, and is in some respects superior to paraffin-paper. The name ‘waxed paper’ is, however, still often used indiscriminately for these various kinds. But let us now prepare our prescription before the customer returns. Although I promised to compound them myself, I do not consider it a breach of this promise to instruct you how to do it, while I overlook the work.”

And turning to the Senior, he added: “You take the second prescription, mixing the ingredients as I directed before, while I write the label.”

This work was soon done, and the Senior was about to lay out twelve paraffin papers for the powders, when the Proprietor interrupted him with the words: “Paraffin-paper by itself does not make a nice-looking package, owing to its thinness and flexibility. I prefer to have another paper around each powder. This is best done by laying out the regular powder-papers first and placing over each a paraffin paper. We then fold both papers together, and thereby obtain a neat package. How many grains should each powder contain?”

The Senior replied: “There are three hundred and ninety grains altogether; this, divided by twelve, makes thirty-two and a half grains. Shall I weigh each powder separately?”

“Certainly,” replied the Proprietor. “You will thereby not only insure accuracy, but also obtain practice in exact weighing, which is of prime importance among the manipulations in our business. I confess that it always proved a source of satisfaction to me when I found that the last powder weighed the exact calculated amount."

The Manager had meanwhile weighed the ingredients of the first prescription, and invited the Junior, who had entered from the laboratory, to mix them. The latter, full of zeal and energy, seized the pestle, and, before he had moved it around twice, some of the very finely powdered pepsin flew out of the mortar.

"More carefully, please," said the Proprietor. "In this case there is nothing to be crushed, and the mixing will be done better by a gentle but steady motion than by an excess of physical force. From these two instances in preparing medical powders you will see how necessary it is to have the full force of your mind directed to your work, and use your powers of reflection at each successive step. Practice and experience help one over many difficulties, but they will never suffice entirely to supplant rightly directed thought."

After the powders had been properly prepared, packed in boxes, wrapped, and the name of the customer with the price written on the outer wrapper, the Junior, wishing to show how he had profited by the instruction of his preceptor, asked: "You told me this morning that in preparing a compound powder the last step of the operation should be sifting. Why did you not sift the powders of these prescriptions?"

The Proprietor replied: "Although general directions are given how to prepare pharmaceutical compounds, yet there are hardly two preparations that can be treated exactly alike. Drugs and chemicals are like individuals. When a child, you were taught how to meet and address grown people, and the rules of refinement and courtesy were impressed upon your mind. But when you grew up, you soon discovered that, although those rules are correct, in a general way, yet each individual has to be approached differently, on account of peculiar whims and inclinations. The successful man in public life, as well as in small private affairs, like our business, is he who can quickly and correctly discover these peculiarities in his fellow-men, and in his actions pay due regard to them, without forgetting his own self-respect. A pharmacist, therefore, should study human nature to insure success. And the same principles apply to the handling of drugs and chemicals. We arrange and classify them according to general characteristics; but the members of any one such group do not always act alike, and their properties show differently under apparently equal conditions. There are latent forces in them that, like hidden gnomes, seem to be waiting for a chance to play a trick on you. The chemist who thinks he knows everything and can do his work automatically, like a machine, will be an easy prey to these goblins. Whatever we do, let us keep the object of our works in view. In sifting powders, the object is the detection and removal of lumpy or partly powdered pieces or gross accidental contaminations. Now, attempt to apply this to our two prescriptions. The one containing the deliquescent salts had to be prepared with the greatest care, to prevent undue pressure or friction. By trying to sift the mixed powder, the friction of the salts against the meshes of the sieve would increase the deliquescence—or, more correctly speaking, force the dormant deliquescent tendency into action—to such an extent that the powdered form would disappear entirely, and a moist magma would be the result. Remember, therefore, that deliquescent powders should not be sifted, unless proper precaution as to temperature and humidity have been taken, as in large manufacturing laboratories. The other prescription did not need any sifting, because there were no lumps, all the ingredients being in finely powdered form before they were mixed. It is different with this prescription, that I prepared yesterday."

He stepped to the prescription-files, and after looking a few seconds for the desired prescription, pointed to the following:

℞ Magnes. Sulph. exs., ℥i;
Pulv. Sennæ, ℥i;
Pulv. Anisi, ℥ss;
Sacch. abl., ℥ii.
M. et ft. pulvis No. i.
Sig.—"A heaping teaspoonful before breakfast."

"The dried sulphate of magnesium, no matter how carefully you keep it, will form small, hard lumps; and the same is true of the sugar. To remove these by trituration in a mortar would be a long and tedious work. In this case the sieve is not only indispensable for detecting them, but also saves time. After sifting off the fine parts, the remainder is powdered in a mortar and, after another sifting, mixed with the first quantity, until the whole mixture is uniform."

"I dislike this repeated sifting," said the Senior; "it is dusty, cumbersome work, and requires an immense sheet of paper under the sieve to collect all the powder."

The Proprietor replied: "That would be the case with large sieves, as they are generally found in the shops, but not with this little contrivance." He took from the shelf a small object that, at first glance, looked like a round, one-pound box with a cover.* (Fig. 1.)

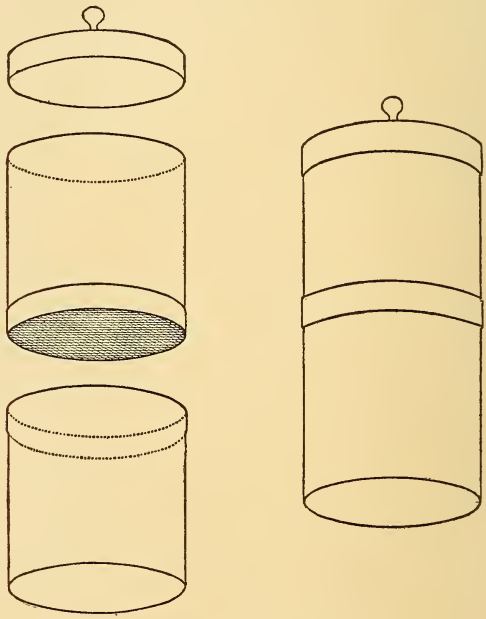
"This is what I call my prescription-sieve," he said. "It consists, as you see, of three parts. The first is a cylinder made of tin-plate, about three inches in diameter and three high, the bottom of which is a sieve. The second part is another cylinder, with an ordinary bottom, a trifle wider at the top than the bottom end of the first one, so that it will slide over it. The third part is a closely fitting cover to the first.

---

* This prescription-sieve is now made by Whitall, Tatum & Co.

To operate the sifter, we conjoin the two cylinders, so that the sieve is about in the middle, put the powder on the sieve, and shut down the cover. Now we shake the apparatus as violently as we please, and after a while remove the lower cylinder, which will then con-

Fig. 1.



tain the sifted powder, while the coarser parts remain over the sieve in the upper cylinder. This little sifter will also serve as a mixer, by sifting the powders forward and backward a number of times, stopping the operation when all is in the lower cylinder. The sieve that I use here is a No. 40, and is stationary; but the apparatus might just as well be constructed with movable sieves, so that different sizes might be inserted. By making the cylinders of hard rubber a very neat apparatus might be constructed. Of its usefulness it is hardly necessary to speak; the small space it occupies, the substitution of the receiving cylinder for the usual sheet of paper, the total absence of dust, the ease with which the powder is collected, and the facility of agitating it slowly or violently, as may be required, are points that suggest themselves to the observer."

After examining the "prescription-sieve," the Junior asked, pointing to the last prescription: "What do the letters 'exs' after 'sulphate of magnesium' mean?"

"They mean 'exsiccatus,' or dried. The term is applied to such salts that by careful heating to a certain temperature have been deprived of most of their water of crystallization. Some salts, like sulphate of iron and sulphate of magnesium, are, on account of their high percentage of crystallization water, not adapted for powders or pills, and the dried form is, therefore, preferred. But in using the one for the other, it must not be forgotten that the dose of the dried salt is considerably smaller than that of the crystals."

"Will you tell me," asked the Junior, "if any other powders besides compound liquorice powder are official?"

"Why, certainly," replied the Proprietor. "In the first place, nearly all vegetable and most chemical drugs are used in powder form, either in prescriptions or in making various preparations of them. If, however, two or more powdered drugs are to be mixed and kept ready for use, like the compound liquorice powder, we have compound powders which in the 'Pharmacopœia' are described under the name of 'Pulveres, Powders.'" Turning to the Senior, he continued: "Can you name the official pulveres?"

"Yes, sir," replied the Senior. "They are Pulvis Antimonialis, or James's powder; Pulvis Aromaticus; Pulvis Cretæ Compositus, or compound chalk powder, used to make mixture; Pulvis Effervescens Compositus, commonly called Seidlitz powder, and consisting of an alkaline and an acid powder; Pulvis Glycyrrhizæ Compositus, or compound liquorice powder; Pulvis Ipecacuanhæ et Opii, or Dover's powder; Pulvis Jalapæ Compositus, consisting of jalap and cream of tartar; Pulvis Morphinæ Compositus, or Tully's powder, claimed to be an improvement on Dover's powder; and, finally, Pulvis Rhei Compositus, also called Gregory's powder, or rhubarb and magnesia."

"That was well done," said the Proprietor, "and you will notice that most of these powders are named after their most important ingredient. They all must be prepared with the greatest care, and their medicinal action depends greatly on the intimate mixture of the various ingredients."

"There is one question that I would like to ask you," said the Junior: "Why are the two Seidlitz powders prepared separately and put in blue and white papers?"

"When both powders," replied the Proprietor, "are dissolved separately in a little water and the two solutions mixed a chemical change takes place. The tartaric acid of the white powder decomposes the bicarbonate of soda of the blue one, forming tartrate of soda, with the liberation of carbon dioxide, commonly called carbonic acid. This is the same gas that, dissolved in water, forms the improperly called 'soda water,' so called because carbonate of soda was originally used in its manufacture. This gas has a pleasing, prickling, and cooling effect, and the solution of the salt is thereby swallowed more easily than it would be otherwise. You know that some people think that the efficacy of the powder depends on this gas. If we should mix the two powders and put the mixture in one paper, the moisture of the air would slowly but surely aid the acid in destroying the molecular combination of the soda, and the moist powder without effervescence would be the result. Papers of different colors are used to distinguish the acid from the alkaline powder without examination."

CHAPTER III.

COMPOUND TINCTURE OF CINCHONA — PURITY OF DRUGS—PERCOLATION AND MACERATION—TINCTURES FROM FLUID EXTRACTS.

While speaking, the Proprietor's eyes fell on a small slate that lay on the table before him. This slate was generally suspended at the wall near the entrance to the laboratory, and served as a registry for such preparations as should be prepared during the day. Every clerk had strict instructions to note down all the articles that he noticed to be almost sold or consumed, either in the want-book, kept for this purpose at the desk in the store, or on this slate whenever the article was a production of the laboratory.

"I see that compound tincture of cinchona has to be made," he said, and opened the "Pharmacopœia," a copy of which, together with various other standard works on pharmacy, were kept on a small shelf over the general working-table of the laboratory. Pointing to the formula of the wanted tincture, he made the Junior bring the tin cases that contained cinchona-bark, orange-peel, and serpentaria, and, after weighing the required quantities, directed him to grind all together in a mill.

The stock-bottles, in which the various tinctures, syrups, liniments, and fluid extracts were kept, until needed in the pharmacy, all held five pints, and were green-stoppered packing-bottles. They were a convenient size for the want of the store. Such preparations as were needed in larger quantities were kept in two or more bottles rather than to disturb the uniformity of the array by bottles of various sizes. The compound tincture of cinchona, being one of the tinctures in greatest demand, was generally prepared in quantities of twenty pints, enough for four bottles, or, since the introduction of the metric system, in quantities of ten thousand cubic centimetres,—that is, ten times as much as the formula of the "United States Pharmacopœia" prescribes.

"This is another freak," said the Junior, who found much to criticise on this day, turning the mill; "why don't you buy the powdered drugs, as other people do, instead of making me work like a mill-hand for half an hour?"

"You might just as well say, 'Why don't you buy the tincture ready-made, as some lazy druggists do?' Simply because we want to be sure that whatever we turn out is the very best. We do not wish to dispense Makem's or Cheatem's fluid extracts, tinctures, and so on, but our own."

"But why not buy the powdered drugs?"

"Because it is easier to judge the crude bark or root than the powdered; the addition of poor specimens, or even adulteration, is impossible, if we examine the bark itself, but very difficult to discover if we start with the powder. Adulteration is best discovered by the process of assaying, to which we subject our drugs and powders before using them. Take, for instance, this lot of cinchona-bark. According to the 'Pharmacopœia,' it should contain at least five per cent. of combined alkaloids and not less than two and a half per cent. of quinine. This bark fulfils these requirements, the assay having shown 5.3 per cent. of alkaloids and 2.6 of quinine. When it was bought the dealer also recommended a lot of mixed powder for the compound tincture, claiming it to be of the best quality. Now the mixture of cinchona, orange-peel, and serpentaria used for this tincture contains fifty per cent. of cinchona; the assay of it should therefore yield 2.5 per cent. of total alkaloids and 1.25 per cent. of quinine, while it showed only 0.9 per cent. of the former and little more than a trace of the latter."

"Then they tried to cheat us?"

"I would not like to say that," replied the Proprietor. "They even courted examination, and probably believed themselves to offer a perfect article. But it shows that the utmost care is necessary in the selection of the crude drugs. All exactness and precaution in manipulating are of little use if the material with which you work is faulty."

"Well," said the Junior, "I would not deal any more with such people after an experience of this kind."

"You will learn more about these intricate problems as you grow older. How do we know but what they used the very best bark, and a change took place afterwards? The mysteries surrounding the chemistry of alkaloids and their compounds have not yet all been explained, and there still remains a large unexplored field for the searcher of truth. How do we know that the alkaloid which the living plant produces does not undergo a gradual change after the plant life is extinct? May not new products, new combinations, continually be formed? Light, moisture, and air may not only produce a physical change, but also a chemical one; or the different alkaloids and other compounds—some known to us, some unknown—may quietly wage war on each other, destroying, decomposing, annihilating each other, and new combinations arise. Do not understand me to say that I claim that such a change does take place in cinchona-bark; I only express a theory that I believe will some day be expounded and verified. In fact, I might cite instances that strongly point in this direction. We know that the bark of Rhamnus Purshiana undergoes a gradual change on keeping, and large manufacturers of galenicals state that they do not use it until it is two years old. Investigation of the rhizome of Podophyllum Peltatum has also revealed the fact that different results are obtained from the fresh and the old drugs, the latter being richer in medicinal virtue than the former. The conscientious pharmacist should therefore commence with the crude drug in making his preparations, unless there are insurmountable physical difficulties.

"In the case of compound cinchona tincture there is another reason why the drugs should be powdered just before being used. In powdering orange-peel and serpentaria a certain amount of oil is set free, or, rather, pressed out, and would be lost by evaporation, while now the fine cinchona powder will at once absorb and retain it."

"There!" said the Junior; "done."

"Not yet, my friend," said the Manager, smilingly. "If you will read the 'Pharmacopœia' you will see that a No. 60 powder is required for this tincture. I did not set the mill as fine as that, for the grinding-wheels would probably have been clogged. You see," taking out the receiving-drawer, "that the drugs are little more than crushed; we now set the mill a little finer and grind again. We then sift off the powder of the required fineness, and repeat the process with the remaining portion until all is turned into No. 60 powder."

The Junior did as directed, grumbling some words of displeasure; but when, finally, the two thousand grammes of a uniformly powdered aromatic drug lay before him, he could not but applaud his own work.

"I declare," he said, "I never smelled any drugs of such fine flavor!"

"I am glad you appreciate the richness of the flavor," said the Proprietor. "There is hope that you will some day recognize the advantage of our system. What shall we do with the powder now?"

"Moisten it with some of the menstruum," said the Junior; and taking the "Pharmacopœia," he added: "It will take two thousand cubic centimetres of the menstruum, consisting of one hundred and fifty cubic centimetres of glycerin, one hundred and fifty of water, and seventeen hundred of alcohol. Shall I mix these?"

"I prefer in the case of tinctures to prepare all the menstruum at once. It saves time and avoids mistakes. We wish to make ten thousand cubic centimetres, or about twenty pints; therefore take one of the large three-gallon jars, put the liquids in the proper proportions in it, and label the jar 'Menstruum for Tr. Cinch. Co.' What quantities do we require?"

After a little figuring, the Junior replied: "We need seven hundred and fifty cubic centimetres of glycerin, seven hundred and fifty of water, and eight thousand five hundred of alcohol to start with. After using this, we mix alcohol and water in the same proportion, omitting the glycerin."

After having prepared the menstruum, the Junior measured two thousand cubic centimetres, and poured some of it on the drugs before him. Then he mixed liquid and powder with the hands, rubbing the parts that clogged together between the palms, gradually adding more of the menstruum.

The Proprietor watched the process, to be sure that the moisture was evenly distributed throughout the whole mass. Then he said:

"We now put this moist powder into a closed vessel and allow it to macerate for twenty-four hours."

"What is the object of this delay?" said the Junior. "Why do we not percolate at once?"

"For various reasons," said the Proprietor. "The liquid cannot permeate the cellular tissues of the vegetables in a few minutes, and by allowing it some time, a more uniform impregnation is obtained. Then you know that many drugs have the property of expanding or swelling when they are moistened. By putting them directly into the percolator, this property would force the particles close together and press them against the sides, sometimes to such an extent that the percolation would proceed extremely slowly or cease entirely."

The Junior, having finished his work and properly labelled the jar with the menstruum, washed his hands and said:

"My first position was with an old German pharmacist, who made all his preparations himself, as you do, but paid little attention to the American 'Pharmacopœia.' He always used the German 'Pharmacopœia,' in which maceration was the general process for making tinctures. He called percolation a silly innovation, and claimed that no reliable results could be obtained thereby, on account of a number of probable, almost unavoidable, mistakes or deficiencies to which it was subject."

The Proprietor replied: "The number of opponents of this excellent process of exhausting drugs, which was first popularized by Professor Procter, is growing smaller every day. Some old pharmacists, educated at an earlier period by different teachers and under different surroundings than ours, will not or cannot realize that the world is moving and progress being made in every field of art and science; they will, therefore, persist in their opposition to the end of their lives. But that percolation is a better process than maceration can no longer be denied; and even so conservative an authority as the German 'Pharmacopœia' has, in its latest revision, adopted it in a few cases, which will act as the entering wedge for further innovations."

"What are the advantages of percolation over maceration?" asked the Junior.

"Greater simplicity in manipulation, more reliable and satisfactory results, and more elegant preparations are the main points of difference," said the Proprietor. "In maceration you must shake the vessel in which you prepare the tincture at least once a day, in order to mix the lower impregnated strata of the menstruum with the upper ones. If you prepare large quantities, as in our case, such shaking becomes exceedingly difficult, on account of the weight of the material. In percolation no such difficulty arises, and the process is equally adapted to small and large quantities. Then comes the length of time. Maceration extends over eight to twenty days, and a long period is generally preferred, to make sure that all the drugs are equally penetrated by the liquid. But how do we know that they are? And, if they are, will not the elastic fibres of the drugs, sometimes expanded and swollen on the outside, tenaciously retain the active principles, in spite of all the shaking?

"How different it is with percolation! Experience has taught us how long the drugs should be moistened to allow the menstruum to penetrate them thoroughly; in the case of compound tincture of cinchona, twenty-four hours. We then put them into the percolator, packing down evenly, so that no small canal or passage is left for the liquid, and no stratum possesses greater density than any other. The menstruum that now passes from particle to particle cannot but push each saturated part before it, taking its place, and being displaced in turn by the following layer. Gravitation, never ceasing, never varying, is the constant and gentle, but irresistible, power; and no alkaloid can hide itself in the protecting embrace of vegetable fibres; it will be found, dissolved, and moved along. And, finally, when the process is completed, what a cumbersome method maceration proves to be when it comes to clarifying the tincture! Simple draining of the drugs is entirely inadequate, for we know that the richest, the most effective parts will linger in the marc,—that is, the mass of remaining drugs. Pressure must be resorted to, and formerly the tincture-press was as indispensable in the laboratory as the percolator is now. But the sudden great pressure, which takes the place of the mild, gradual power of gravitation, not only removes almost the last drop of liquid from the drugs, but with it innumerable minute particles of the inert tissue and cells that render the tincture unsightly and turbid. Filtration becomes necessary, sometimes repeated three or four times. How much more elegant and quicker is the tincture made by percolation! It appears clear and richly colored from the beginning, no filtration is necessary, and even the last particle of the menstruum can be removed in some cases by driving it out with water. If strictly correct tinctures of a fixed alkaloidal strength are required, an assay has to be made in both cases, whether prepared by maceration or percolation, and experience has shown that the greater exactness is on the side of percolation."

"But the correct packing requires a great deal of care and skill," retorted the Junior.

"The requirement of greater skill in manipulation," replied the Proprietor, "should not be considered as an objection in pharmacy, especially when a better result is thereby obtained. It takes more mechanical skill to build a fine house than a common one; but is that a valid argument that huts and shanties are preferable? More skill is required to make elegant and neat clothes than to make slovenly and misfitting ones; but should we, therefore, say that it is wiser and better to look like tramps? If it is true that percolation presupposes higher pharmaceutical skill, this fact should be a powerful argument in its favor and against maceration."

"If I had my way," said the Junior, "I would neither macerate nor percolate to make my tinctures, but simply reduce the fluid extracts. What an amount of bother that would save!"

"Bother!" exclaimed the Proprietor, with a voice in which anger and irony were mingled; "you young people adjudge everything by the amount of inconvenience it causes you; no other thought accompanies you in your work. The desire to avoid or reduce 'bother' has opened the field for the large manufacturer, the tablet-maker, and the physician-supply furnisher. Even the physician catches the echo of your abominable cry about bother, and kindly relieves you of the trouble of preparing prescriptions by dispensing his own preparations. And then, when you are free from all bother, even from the annoyance of waiting on customers, you complain about bad times and selfish physicians, scold the public and the manufacturers, and call pharmacy a profession of the past. I tell you, young man, there are still some pharmacists to whom laboratory work is no bother, but a pleasure, and the harder the work the greater the pleasure; men who rejoice in what you call bother, and who find ample reward in the result of their work. Shame on you and your bother! Do you think that such indolence would have led Scheele to have discovered oxygen, or Sertürner to find morphine? Imagine Procter fearing the bother of percolation, or Maisch the bother of his tedious but faithful examination of ethereal oils! Take any of the living pillars of pharmacy, at our various colleges or in their private laboratories, and tell me whether it is not the bother of studying and striving that has made them prominent. How can you expect ever to succeed in a profession that is nothing but bother to you! And now let us see whither your freedom from bother will lead you in the case of tinctures. You will make tinctures from fluid extracts. This means that fluid extracts are concentrated tinctures, and tinctures diluted fluid extracts. Let us see if this is true. Take the fluid extract and tincture of cinchona. The prescribed menstruum of the former is a mixture of eight hundred parts of alcohol and two hundred of water; that of the tincture consists of six hundred and seventy-five parts of alcohol, seventy-five of glycerin, and two hundred and fifty of water. It is evident that the first-mentioned menstruum will exercise a different solvent power on the alkaloids of cinchona than the latter, so that the fluid extract can never be turned into a tincture by mere dilution. Or take hyoscyamus. The menstruum for the fluid extract is a mixture of two parts of alcohol and one part of water; that for the tincture, diluted

4

alcohol. How can the one finished product be made from the other? Let us go still further. Fluid extract of digitalis is made with a mixture of six parts of alcohol and three parts of water, and therefore contains principally those constituents of digitalis that are soluble in alcohol. We also have an infusion of digitalis in which water alone is the menstruum, the alcohol being added afterwards simply to preserve the infusion, but not to dissolve; it therefore contains only those principles that are soluble in water. And yet, to save bother, you would simply dilute your fluid extract, producing a mixture entirely different in composition—and, consequently, in therapeutic action—from the true infusion. No wonder, then, if the physician relieves you also of the bother of diluting the fluid extract."

"But could not the fluid extract be made with the same menstruum as the tinctures?" ventured the Junior.

"Then such preparations would be no fluid extracts, nor would you have saved any bother; for you would have to make your fluid extract and then your concentrated tincture, while in reality it would be less bother to make the regular tincture than the concentrated."

"But do not manufacturers of fluid extracts print on the labels directions for making tinctures, syrups, and infusions of the respective drugs from the fluid extracts?"

"I know that they do; but such labels are simply lies, intended for unscrupulous and lazy pharmacists who are afraid of 'bother.'"

"Well, that surprises me," said the Junior; "considering that so many druggists and doctors use the fluid extracts for making their tinctures, I hardly think they are aware of doing any wrong."

"If they are not aware that the formulas for fluid extracts differ in more respects than strength from those of tinctures, they should not follow a profession where their ignorance might lead to serious consequences. To show you more clearly that fluid extracts are not merely concentrated tinctures, let us take any of the preparations of a well-known manufacturing firm, whose goods we are compelled to keep, because one of our physicians insists in ordering them in preference to our own. Here is the fluid extract of rhubarb. On the label we read:

Formula for making Tincture of Rhubarb, U.S.P.:

Fl. Ext. Rhubarb, 1 fl. oz.;
Fl. Ext. Cardamom, 96 min.;
Glycerin, 1 fl. oz.;
Alcohol, $5\frac{1}{5}$ fl. oz.;
Water, $2\frac{3}{5}$ fl. oz.

"You see that the formula will make about ten fluidounces, of which five and one-fifth are alcohol. The official formula for the tincture of rhubarb contains sixty per cent. of alcohol; the ten fluidounces should therefore contain six fluidounces. There seems to be a difference of four-fifths of a fluidounce; but this is supplied by the fluidounce of fluid extract, the menstruum of which contains eighty per cent. of alcohol,—that is, four-fifths of a fluidounce in one fluidounce. So the amount of alcohol is correct. There should be three fluidounces of water in ten fluidounces of the tincture. The above formula provides for two and three-fifths fluidounces, and one-fifth of a fluidounce comes from the fluidounce of the extract, making two and four-fifths fluidounces. The last fifth must therefore be furnished by the fluid extract of cardamom, a non-official preparation, made by the manufacturer, according to this formula, with water as menstruum; for if it contained any alcohol, there would be an excess of this liquid in the finished tincture of rhubarb. But this is by no means the only irregularity. The ingredients of rhubarb are partly soluble in water and partly in alcohol. A menstruum containing eighty per cent. of alcohol will, therefore, dissolve different ingredients than one containing but sixty per cent.; or, if we suppose that the fluid extract represents all the active principles of the drug, so that nothing but inert vegetable fibres are left in the marc, then the tincture cannot do so, and a diluted extract is no tincture. The ten per cent. of glycerin in the tincture is added to the menstruum of the tincture to prevent the deposit of chrysophanic acid on standing. But as there is no glycerin in the fluid extract, and the manufacturers are very particular to filter their preparations before sending them out, we are justified in saying that the chrysophanic acid has been removed from the extract, and the subsequent addition of the glycerin cannot, of course, restore it."

"But do not the manufacturers claim that the two menstrua, though they differ, will dissolve the same ingredients?"

"Suppose they did, would the admission of the correctness of such an unproved claim not be a slur on the revisers of the 'Pharmacopœia,' who would then have increased the alcoholic strength of the fluid extract unnecessarily and caused the pharmacist a useless expense? If you put on one side the arguments and statements of a number of scientific men of the highest national repute, and on the other the claims of a manufacturing firm whose chief aim is to make money, I do not believe there can be any doubt as to which you will think is right."

After a while the Junior said: "Which of the two preparations—the fluid extract or the tincture—represents the drug better?"

"If you mean by representing a drug better that the liquid preparation shall contain in the most accurate manner all the ingredients of the crude drug, then the fluid extract is without doubt the better of the two. In the first place, a cubic centimetre of the fluid extract corresponds in every case to a gramme of the drug; and, in the second place, the *modus operandi* of all consists in first percolating a part, generally eight-tenths of the required quantity, and then exhausting the drug,—that means continuing percolation until the menstruum comes out of the percolator unchanged in color and odor. The second percolate is evaporated to a thick extract, which, in turn, is then dissolved in the reserved portion (first percolate). By this method it is supposed that a fluid extract is prepared representing the drug exactly."

"You say it is 'supposed,'" said the Junior; "does it not always do so?"

"I do not think that anybody would be willing to affirm this question without reserve," replied the Proprietor. "There are various difficulties that the careless observer may overlook. The menstruum may run clear and unchanged through the percolator and yet leave undissolved particles in the 'marc,' as the remaining exhausted mass of vegetable fibres and tissues is called. The proper proportions of alcohol and water, and sometimes glycerin, or of various other liquids, as acids or ammonia, necessary to fully exhaust the various drugs, have by no means as yet been ascertained. In spite of the most careful experiments and observations, we discover again and again that the menstruum employed is more or less defective, and the numerous changes that every new edition of the 'Pharmacopœia' shows in this respect are the best proof hereof. A second difficulty exists in the evaporation of the second percolate. Vegetable principles are exceedingly sensitive to temperature and light, and no one can assert that the thick concentration contains the active principles in the same proportion as the liquid did, nor even that the same active constituents are present. The difference in color and odor of similar fluid extracts from different manufacturers is probably traceable to some oversight in evaporating, and shows how difficult it is to prepare a perfect extract. And even the claim that the fluid extract represents the drug, drop for grain, is correct only for the individual drug that has been exhausted. But how do we know that two different lots of drugs, like aconite or belladonna, are alike in strength and action? Both may have been thoroughly exhausted, and yet the one fluid may be different from the other. The only absolute safeguard against varying the preparation is standardization of every preparation, and not until a process of assay has been established for every tincture and fluid extract can the 'Pharmacopœia' be considered a perfect book."

"Are not tinctures subject to the same objections as fluid extracts?" asked the Junior.

"Not to the same extent," replied the Proprietor. "No claim is made for them that they are true representatives of the drugs. They simply are alcoholic or hydro-alcoholic solutions of certain active ingredients which have been studied well and whose therapeutic actions are known. Their strength can often be figured out to exactness; and if they contain the official amount of one or more alkaloid, as the case may be, they fulfil their object. The question of what remains in the marc is of little account; and as we know perfectly well what menstruum will dissolve a certain alkaloid or resin, there is less probability of an error in this subject. A well-prepared tincture is, therefore, a reliable form of medication, and not a few physicians, after having thoroughly tried the tablets and triturates without satisfaction, gradually come back to this form of medication."

"I should think," said the Junior, "that the alcohol present in the tinctures would often be very objectionable."

"So it is," answered the Proprietor, "and efforts have repeatedly been made to find a less objectionable yet equally good solvent. I understand that there is a school ot physicians in London who reject alcoholic tinctures entirely, and use glycerin or mixtures of glycerin and water and acids as the menstruum. But, although glycerin is quite an excellent solvent, it is inferior to alcohol, especially in such cases where the medical virtues depend upon oils or resins, and I fail to see how therapeutically satisfactory tinctures can be made with it. If this deviation was a success, we certainly would hear more of it. You may now look through the 'Pharmacopœia' and make a memorandum of the various tinctures, arranging them according to the percentage in which the drugs are used in their preparations. I am wanted in the store."

CHAPTER IV.

DRUMMERS—ACCOMMODATING THE PUBLIC—OFFICIAL TINCTURES—CLASSIFICATION OF TINCTURES—TURBIDITY OF TINCTURES.

The Proprietor turned towards the door, where the Senior stood with a card of a visitor in his hands. Taking the card and glancing at the name, a cloud of displeasure passed over his face. "This is the third tobacco drummer to-day," he murmured; "I wonder if they will never get tired of annoying us."

However little he liked the unwelcome interruption, he approached the caller in a friendly and pleasant way, and patiently listened to his loquacious introductory remarks. But when the salesman proceeded to unpack his samples, he interrupted him by saying:

"I believe your time is as valuable to you as mine is to me. I am not in need of any more cigars, which I keep simply to follow the general custom, not that I care much for the small profit that I derive from their sale. Therefore I think I do you a favor in asking you not to waste your time on an unworthy object; and, while I thank you for your visit, I must ask to be excused."

These remarks, uttered with the greatest politeness and decision, seemed to unnerve the stranger completely; but, after recovering himself, he took from a case a couple of fine cigars and offered them to the Proprietor, with the words, "Have the kindness to try one."

"I thank you," replied the Proprietor; "I never smoke in my store."

"But you sell cigars," said the salesman.

"If any of my customers choose to smoke here, I certainly cannot object. But I would set a bad example to my employees if I should indulge in a pastime or weakness—whichever you may call it—that is objectionable to a great number of my customers, especially the ladies. A physician or pharmacist should never be offensive in any respect; hands, clothing, or breath should have no odor of tobacco or liquor; and while a moderate indulgence is certainly allowable, it should be avoided in the place where it might give offence and work injury. I bid you good-morning, sir."

Bowing courteously, he withdrew, leaving the salesman to gather his parcels and depart.

"Postal stamp," ejaculated a burly young fellow, who had entered the store; and the Proprietor quickly handed him the desired article, receiving the two cents with the customary "Thank you, sir."

After the customer had departed, the Manager addressed the Proprietor: "I often admire your equanimity, of which quality I possess only a limited amount, I am sorry to say. If, after the unwelcome interview with the drummer, this uncouth fellow had asked me for a postal stamp, I should have told him to go to—the post-office."

The Proprietor smiled and replied: "Your praise of my equanimity is an admission that my way of meeting these tiresome customers is better than yours, and you would do well in following my example. We pharmacists are used by many people as media of general accommodation. We are expected to give information on diseases, doses, poisons, and antidotes; to know how to feed babies and how to keep them quiet; to give the address of every person that has come to, or moved out of, this place for the last ten years; to keep a directory and writing-desk for public use; to write addresses on envelopes, and know how much postage a letter or package will require; to be informed on railroads, steamboats, theatres, concerts, and church fairs; to know where ladies can procure servants and servants find positions; to be a general information bureau on history, literature, politics, and music; in fact, to know everything that nobody else knows. There are only two ways to follow: we must either refuse all favors to every one, or give what information we can pleasantly and willingly, as the sun gives us light, or the clouds send us rain. To frown upon everybody who asks us for a postage stamp, or even to moralize with him, is sheer folly. To refuse a favor on the plea of inability may be disappointing, but it will give no offence; while to grant a favor with displeasure and anger shows lack of good manners, and is an insult to the receiver, who would probably have preferred not to ask."

"But I sometimes think," replied the Manager, "that people impose on your kindness and good nature."

"It is better," said the Proprietor, "to overlook and disregard such imposition than to be accused of a lack of courtesy. Of course, such things can be overdone, and a man may make himself a slave or clown to every Tom, Dick, and Harry; but a man of self-respect knows where to draw the line, and that is what I should like to do in reference to cigar agents. I have had enough of them for to-day, and would ask you to tell them in future that I do not need their services."

"Let me do so," interrupted the Senior. "I will 'give it to them' so thick that they will think of us ever afterwards."

"I believe you would," said the Proprietor, laughingly; "but probably not in my way. Do not forget that these men work very hard and earnestly strive to serve us. Occasionally they may be annoying, as was the cigar-man before; but you should always treat them with courtesy. The better ones among them, who have gathered experience and sagacity, know very quickly when they annoy, and act accordingly. A salesman is in many respects like an orator: most of them utter many words and say really little, and the result of their harangue is in inverse proportion to their loquacity; only the good ones know where to stop."

After these words he returned to the laboratory, where he found the Junior with the 'Pharmacopœia,' trying to classify the tinctures according to their strength.

"I never thought there were as many as seventy-two tinctures," said the young man.

"And you might add," replied the Proprietor, "as many unofficial ones that are often ordered. Tell me what observations you have made in arranging them?"

"In trying to classify them according to the percentage of drugs represented in them, I find that most of them contain a multiple of five. I have four with five per cent., twenty-three with ten per cent., ten with fifteen per cent., twenty-five with twenty per cent., one with thirty-five per cent., and two with fifty per cent. Besides these, there are five whose percentage strengths are no multiples of five,—namely, compound tincture of opium, containing only 0.4 per cent. of the most active ingredient, or 1.6 of all the physiologically active constituents combined; the tincture of nux vomica, containing two per cent. of the extract. The third one I cannot classify,—namely, the compound tincture of lavender."

The Proprietor said: "It is a one per cent. hydro-alcoholic tincture of aromatics. To classify this preparation the corresponding quantity of drugs from which the oils of lavender and rosemary are gained must first be figured. As it is now, it is a preparation consisting of a mixture of a spirit and a tincture, formerly called 'compound spirit of lavender,' and you know that the public clings to this name. The change in the name as directed by the revisers of our 'Pharmacopœia' does not seem to have been very fortunate, and was probably made to have the title correspond with that of the corresponding British preparation. If instead of this new name, which is as improper as the old one, the cinnamon, cloves, and nutmeg had been dropped and replaced by a corresponding quantity of their oils, a preparation would have been obtained that was really a spirit, and might have been colored red by some harmless substance."

"Is there no red coloring tincture official?" asked the Junior.

"There is not," replied the Proprietor, "and I regret this very much. Such a tincture might have little or no medical value; but every pharmacist knows how often he is required to impart a red color to various preparations. By introducing such a coloring tincture uniformity of colorific effect might be obtained, and elixirs and other preparations be made to look alike. A fine yellow tincture, used only for coloring purposes, is the tincture of crocus; a red one is lacking. But let us return to our tinctures. Besides that of lavender, there are two more that are no multiples of five; what are they?"

The Junior looked at the schedule and said: "Tincture of iodine, containing seven per cent. of the element, and tincture of ferric chloride, containing twenty-five per cent. of the solution of ferric chloride, or 13.6 per cent. of the anhydrous salt."

The Proprietor interrupted him by saying: "The designation 'tincture' for the iodine preparations is not a proper one. According to the definition of 'spirit' it should be spirit of iodine, for it is a solution of a volatile substance in alcohol."

"Why, then, was not this name adopted?" asked the Junior.

"Probably in order not to confuse the public, who would continue to ask for 'tincture' of iodine, just as well as they continue to ask for 'spirit' of lavender. You see by these two examples that even such prominent men as the revisers of our 'Pharmacopœia' at times lack consistency. The tincture of ferric chloride also looks like an anomaly. Made from the liquor, the question naturally arises why the liquor is not simply diluted with water. If iodine tincture was put where it belongs,—among the spirits,—and the iron tincture classed as a diluted liquor, we should arrive at the correct definition of the word 'tincture,'—namely, an alcoholic or hydro-alcoholic solution of physiological active constituents of vegetable or animal drugs. You see that, with the exception of the five of which we have made special mention, all tinctures represent the drugs in a percentage that is a multiple of five, evidently from the influence of the metric system.

"Here we might mention two other preparations, allied to the tinctures, but differing from them in the menstruum, which consists of diluted acetic acid, the aceta or vinegars."

"I know the vinegar of squills," said the Junior, "used to make the syrup."

"The other official one is Acetum Opii, or vinegar of opium. Both vinegars contain ten per cent. of the drug, and the opium vinegar is rendered more pleasant by the addition of some nutmeg and sugar."

"Why not make all tinctures ten per cent., so as to have uniformity in them?" asked the Junior.

"This question has often been asked and argued," replied the Proprietor; "and though its affirmation and acceptance appear tempting at first sight, the change will probably never take place, owing to practical difficulties. In the first place, the doses of the five per cent. tinctures—like that of cantharides or of strophanthus—are already very small, and would be still smaller if their strength were increased to ten per cent., while the dose of those of higher percentage, if reduced to ten per cent., would become so large that the stimulating effect of the alcohol in them might overcome the therapeutic action of the drugs. Another kind of uniformity is often asked for and advocated,—namely, that of the doses. Why not make tinctures so that the dose of each of them is always ten or twenty drops?"

"It would be easier then to write prescriptions," replied the Junior.

"Yes, and it is very likely that these practitioners, who live in a continuous warfare with the doses of their remedies, are the originators of such recommendations. It is the question whether all our tinctures could be made to conform to such a requirement. Some of them would be stronger than their corresponding fluid extracts. But the main objection lies in the fact that the dose of hardly any drug is fixed. New investigations, and, consequently, new discoveries of alkaloids and other constituents, continually modify the doses of drugs, and this would naturally cause much confusion, by necessitating repeated alteration in the quantities of drugs. Another classification of the tinctures, and one of great importance to the pharmacist as well as to the prescriber, is their arrangement according to the alcoholic strength of the menstruum. The lack of such knowledge is sometimes the cause of disagreeable controversies."

"In what respect?" asked the Junior.

"You remember," answered the Proprietor, "the noisy and discourteous complaints of a physician a few days ago, who claimed that his prescription was not properly filled. He had ordered a mixture of tincture of tolu and syrup of wild cherry, and expected to receive a clear mixture. His intention was to administer tolu in stronger doses than the syrup contains; but by ordering the tincture he forgot—perhaps he never knew—that it is an alcoholic solution of a balsam, and that the latter, being almost insoluble in water, would be precipitated by the addition of any syrup, because alcohol possesses a greater readiness to mix with water than to retain a balsam in solution."

"It is, then, the addition of water to alcoholic tinctures that causes them to become cloudy or turbid?" asked the Junior.

"Very often it is," replied the Proprietor. "Any tincture that contains oil, gum, resin, or balsam in solution will lose its brilliancy more or less by the addition of water, and physicians should remember this if they expect clear preparations."

"But could we not filter the precipitated matter out of the mixtures?"

"Very often the particles of oil or gum are so minutely divided that they defy the intervention of a filter. But even if we could clarify these prescriptions without the help of such filtering media as magnesia, talcum, or calcium phosphate, the question arises, whether we do not thereby remove all the active principles of the drug, so that the patient receives a clear, palatable liquid, perhaps, but no effective medicine. It is claimed that this is the case with many of the elegant elixirs and wines that some manufacturers induce physicians to prescribe, and the public to take, under the noisy flourish of the advertising trumpet."

"I remember," said the Junior, "that not long ago, in my former position, I had a controversy with a customer, who asked me for glycerin, rose water, and benzoin, equal parts, which she intended to use as a lotion for the skin. I mixed equal parts of the ingredients; but the bottle was soon returned, with the remark that something was wrong. The owner of the store, however, knowing that I had given exactly what was asked for, supported me, and the lady had to keep the lotion."

"You probably never saw her after that," said the Proprietor.

"I do not remember that we did," replied the young man. "Would you not have acted in the same way?"

"I would not," replied the Proprietor; "it is one of those cases where strict but thoughtless adherence to a given rule may work mischief. If you had given the customer a mixture of rose water and glycerin, with a few drops of benzoin, she would have had a better preparation for her hands and thought a good deal more of your ability. The benzoin in that combination is added as a mild antiseptic, or as a flavoring agent, though superfluous in either capacity. A few drops would have imparted a peculiar aroma to the lotion, while the quantity that you put in produced a copious layer of benzoin on the surface, sticking obstinately to the skin and destroying the intended action of the preparation entirely."

"But she asked for equal parts," interposed the Junior.

"It should be our rule to follow directions strictly but intelligently. If a physician orders equal parts of Fowler's solution and water, with the direction to take a teaspoonful, it is not only our right, but our duty, to confer with him, or, if he be inaccessible, to change the prescription to the best of our judgment. If, then, in cases of danger, such alterations are compulsory, why should we not use the same discretion when commercial interests are involved? Experience will teach you that the public is apt to ask for many things under wrong names, in wrong quantities, or even under erroneous impressions as to their medicinal virtues, and, besides, to refuse to accept any enlightenment on their errors. It is the province of the skilful druggist to quickly detect what is really wanted, and to quietly modify the order in such a way that the object is reached without destroying the confidence in the dispenser or the belief in the customer's own superior knowledge. As professional men, we have but one course,—to strictly follow the directions of the physician and the 'Pharmacopœia'; but as long as we must also be tradesmen, for the sake of earning a living, we should not allow our professional dignity to override the shrewdness that common sense bids us to practise.

"Now let us return to our tinctures. We have seen that the most common cause of unsightliness in mixtures is the addition of water to alcoholic tinctures;

but this is by no means the only cause. Alcohol, for instance, may be the disturbing element. Not long ago the following prescription was brought to me:

℞ Tinctura arnicæ,
Spir. vini rect., āā ℥iv.
Fiat linimentum."

"You do not mean to say," interrupted the Junior, "that such a mixture was not clear?"

"Try it," said the Proprietor.

The Junior was about to take an eight-ounce graduate, but his preceptor interfered. "Why do you take so much?" he asked.

"The prescription calls for eight ounces."

"But you are not preparing the prescription; you only wish to make a certain test, and there is no need of wasting so much valuable material."

The Junior thereupon took a one-ounce graduate, and poured into it first two drachms of arnica tincture and then two of alcohol. On stirring the two liquids, a copious, light-brown precipitate was formed.

"Well," he exclaimed, "I never thought that alcohol could do this!"

"And can you tell me why this precipitate is formed?" asked the Proprietor.

After reflecting, the Junior said: "There seems to be but one explanation. The ingredients of arnica flowers are more soluble in water than in alcohol, and the water of the tincture being withdrawn by the alcohol, they are precipitated."

"So it is," said the Proprietor; "and in this case, too, the physician came to me and complained that he had ordered the same liniment before and obtained a clear mixture. The reason probably was that the druggist who prepared it before had evaded the bother of making his own tincture of arnica by simply diluting the fluid extract, which is made from the arnica root with a more alcoholic menstruum, and will easily bear further addition of alcohol. Thus, the outer elegant appearance is not always a guarantee of the actual medical strength, any more than a stylish coat is a guarantee of the real worth of the wearer."

"Now tell me if there is another cause of turbidity, besides the menstruum, on mixing various liquid preparations?"

"I do not see what else could be the cause," said the Junior.

"And yet there are causes of quite a different nature," answered the Proprietor; "a chemical change may take place, resulting in the formation of an insoluble compound."

Noticing the inquiring, doubtful look of the Junior, he continued: "A prescription that we often prepare is the following:

℞ Liq. Plumbi Subacet., ℥ii;
Tinct. Opii, ℥ii.
Fiat linimentum.

The Junior poured the two liquids into a small graduate in the prescribed proportion, and witnessed the formation of a thick, cloudy precipitate in the glass.

"In this case the two menstrua have nothing to do with the result," said the Proprietor. "The cause is rather a chemical one. Opium contains many ingredients, and, among others, an acid called meconic acid, which has the property of forming a precipitate with various salts of heavy metals, among them lead acetate. Would we be allowed to filter the preparation?"

"No," said the Junior; "for we would then remove a part, if not all, of the lead, on which some of the medical effect of the liniment depends."

"Certainly," replied the Proprietor; "and in dispensing such a mixture a shake-label should be attached to the bottle. The nature of the precipitate in this case and the chemistry of its formation are well known; but there are other instances where a satisfactory explanation is not so easily found. Quite a puzzling case happened to me the other day, of which I have not yet found a perfectly satisfactory solution. This is the prescription:

℞ Tinct. Cinchon. Comp.,
Tinct. Calumbæ, āā ℥ii.
Misce.

"The Manager, who prepared it, came to me with it and showed me an unsightly mixture, with a thick, flocculent precipitate."

"Well," said the Junior, "if I remember rightly, the two tinctures have quite different menstrua, and this circumstance was probably the cause of all the trouble."

"Let us try," said the Proprietor. "First, prepare a small quantity of the menstruum of the compound tincture of cinchona. It consists of seventy-five cubic centimetres each of water and glycerin and eight hundred and fifty cubic centimetres of alcohol. Dividing these figures by twenty-five, we have three and thirty-four. Therefore mix three cubic centimetres of water and three cubic centimetres of glycerin and thirty-four cubic centimetres of alcohol. Now take ten cubic centimetres of this menstruum and add to it ten cubic centimetres of tincture of calumba. What do we observe?"

The Junior, after stirring the mixture, said, "This gives us a perfectly clear mixture, and shows us that the menstruum of the compound cinchona tincture is not the disturbing element."

"Correct," said the Proprietor; "and now let us try the menstruum of tincture of calumba, which is a mixture of six parts of alcohol and four of water."

The Junior mixed the two liquids in the desired proportion, preparing ten cubic centimetres in all, and then added the same quantity of compound tincture of cinchona. A very slight turbidity was noticeable, but no precipitate formed.

"You see," said the Proprietor, "that, although the cinchona tincture is slightly affected by the weaker menstruum, we can hardly speak of a precipitate, and our experiments show that the two menstrua are not the cause of serious trouble. Now mix the tinctures."

The Junior took ten cubic centimetres of each tincture, and, on mixing, a thick, yellowish precipitate formed.

"This precipitate," said the Proprietor, "is a subject of great interest to the pharmaceutical student, and deserves to be examined thoroughly."

"Can't we tell what it is from the ingredients of the two drugs?" asked the Junior.

"In the first place," said the Proprietor, "there are more than two drugs present. There is calumba in the one tincture, and in the other there is cinchona, orange-peel, and serpentaria. But even if we take only the two prominent ones,—calumba and cinchona,—we can but surmise what it may be. One plausible explanation is this: The principal ingredients of cinchona are a number of alkaloids, foremost among which are quinine and cinchonidine, and these are very ready to form salts with free acids. Calumba contains such an acid,—calumbic acid; and it is not improbable that an insoluble compound is formed by the action of this acid on the alkaloids. But there are other possibilities, which I will not mention now. It would require a series of very careful examinations to say with certainty what this precipitate is, which was as great a surprise to the prescriber as it was to me."

After a while the Junior said: "I thought chemistry had advanced to such perfection that nothing was hidden from its analyzing search-light, and yet here we have a seemingly simple preparation that is so difficult to explain."

"Perfection!" exclaimed the Proprietor. "What a mockery such a word is, if applied to the results of almost any science! It is true that chemistry has made wonderful strides in the last twenty years, and yet how little do we know, if we try to solve its deep mysteries! Take any of the chemicals on our shelves. Here, for instance, is sodium bromide. We know that it is a compound consisting of one molecule of bromine and one molecule of sodium; that it crystallizes in colorless, cubical crystals; that it has no odor, but a slightly bitter saline taste. We can easily figure out its atomic weight, examine its behavior under various temperatures, determine its solubility in water and other liquids, and say what other elements or compounds will decompose it. We know also that it has certain actions on the animal system; that it acts as a sedative and produces sleep. Having learned all this, we are proud of our knowledge and imagine that we know everything that can be known about this salt.

"But let us go a little deeper. How is it possible that an amorphous, soft, silver-white metal and a dark-brown liquid combine to form such a regular crystal? We know nothing of the power that moves them, and cover our ignorance by calling it 'chemical affinity.' Why do these crystals liquefy in water? We do not know. Why are they colorless and not red or blue? Why do they act on the nervous system and not on the bowels? Why are they not poisonous, while the two elements that compose them are so in a high degree? These and many other questions may be asked, and the same answer comes every time: 'We do not know.' There is one undeniable truth that our so-called perfection in chemistry demonstrates, —namely, that our knowledge of the mysterious forces in nature is only elementary, and that what we know about elements and their compounds is infinitely little compared with what we do not know."

CHAPTER V.

INCOMPATIBLES—FLUID EXTRACTS—WATER-BATH—REGAINING ALCOHOL—DISTILLATION—SUBLIMATION—SOLID EXTRACTS—STANDARDIZATION—OLEORESIN—DISCIPLINE.

"Are not the preparations that cause unsightly precipitates called 'incompatibles'?" asked the Junior of his preceptor.

"In most cases they are. Sometimes it is the intention of the prescriber to produce just such results," replied the Proprietor; "but since you use the word 'incompatible,' I may perhaps answer your question better by asking you what the term 'incompatible' means?"

"I always supposed that it related to medicines that should not be taken together."

"The word has a broader meaning than that, although we hear it mostly when applied to medicine. As derived from the Latin, it means 'not suited together;' and preparations are, therefore, called incompatible when their ingredients, for some reason or other, do not form a satisfactory congruent combination. Now let us see what these reasons may be."

The Junior interrupted him by saying: "If the different ingredients form new, unexpected compounds, different in their properties from the original ones, they must be incompatible."

"Certainly," replied the Proprietor; "and which is the science that treats of such changes?"

"Why, chemistry?"

"How, therefore, would you call such incompatibles?"

"'Chemical incompatibles;' but how do we know beforehand that such changes will take place? The resulting precipitate tells us only after the mischief has been done."

"There need not be a precipitate at all; mixtures may be perfectly clear and brilliant and yet be chemically incompatible. General rules can hardly be given; each prescription must be examined by itself, and the only way to avoid mistakes is to study chemistry. If for no other reason, this one is important enough, why all prescribers and dispensers of medicines should be chemical students; and any school of medicine or pharmacy that does not enforce a thorough, exhaustive course in theoretical and practical chemistry should be closed as a public nuisance, apt, in its ultimate results, to endanger the health, if not the lives, of the public. Let us now consider a prescription with chemical incompatibles. We need not go far; there are a great number on our files."

As he said this, the Proprietor took the following prescription from the files:

℞ Argenti Nitratis, 0.05;
Aquæ Anisi, 60.
Misce.

"This looks harmless enough, but the patient would never get any—or only a little—silver nitrate, for this salt has the tendency of decomposing in the presence of organic substances. The anise water contains only very little organic matter, yet enough to be the cause of a black precipitate of metallic silver, if the prescription is prepared as ordered."

"What did you do when it was presented?" asked the Junior.

"I took distilled water instead of anise water, as you will see by the note on the prescription. Silver nitrate should only be dispensed dissolved in distilled water.

"Then, again, there are prescriptions that are pharmaceutically incompatible," the Proprietor continued, "when in their preparation some soluble ingredients are precipitated. To this class belong those of which we spoke before."

"I remember one," said the Junior, "that the Manager prepared yesterday. It contained tincture of guaiac, tincture of aloes, and water; and the gums were precipitated from their solution in the mixture. But what can a pharmacist do in such cases?"

The Proprietor replied: "If we know the physician well enough, and are sure that he will not be offended by calling his attention to such an error, it is best to do so. But even in that case it is advisable to make a modest suggestion rather than point out directly his ignorance of pharmaceutical manipulation."

"For instance, in this case?" asked the Junior.

"I would say," replied the Proprietor, "'Doctor, if you will allow me to use a little mucilage of acacia in this prescription in place of some of the water, the resinous matter will remain better suspended.' He would probably answer, 'All right,' and remember it in the future. But suppose I should say, 'Doctor, this makes a terrible-looking mixture; can't you order something better?' This adverse criticism and his inability to suggest a remedy would irritate him, and I would suffer by it."

"But suppose we cannot find the physician, or do not care to approach him?" asked the Junior.

"In that case we must follow our own judgment; and, if we conclude to dispense the prescription as written, we should mix the resinous ingredients with a very little water at a time, shaking or stirring after each addition; and, finally, put a 'shake-well' label on the bottle."

"What is the third kind of incompatibility?" asked the Junior.

"Therapeutic incompatibility," said the Proprietor. "It takes place when one ingredient counteracts another in physiologic action and thereby destroys its therapeutic effect. For instance, if chloral were ordered dissolved in whiskey, one ingredient would act as a sedative, the other as an excitant and stimulant, not to mention the possible chemical change that may happen by the formation of a chloral alcoholate."

"I should think a physician would not make such a mistake," said the Junior.

"There is no telling what the doctors may do. In pharmacy, as in many other callings, eternal vigilance is the only guarantee of success."

After these words the Proprietor walked to the "percolating-table," by which name he called a table on which a number of upright iron rods were fastened to hold rings of various sizes for percolators, funnels, or other implements.

"Here is another part of our pharmaceutical work," he said, "closely allied to tincture-making, and yet different in many ways. This percolator holds fifteen hundred grammes of powdered cascara sagrada bark, which has been exhausted by a menstruum of diluted alcohol. We wish to make fifteen hundred cubic centimetres of fluid extract of it, and reserved the first twelve hundred cubic centimetres, which naturally contains the largest amount of extractive matter. The balance—a rather larger quantity, as percolation was continued until the drug was exhausted—must be evaporated to a soft extract and then be dissolved in the reserved portion. Let us, therefore, proceed to evaporate it."

The Junior poured the percolate into a large evaporating-dish, put it on the gas-stove, and proceeded to light the gas.

"Wait a minute," said the Proprietor. "From what I told you before, you should know that nothing will destroy the delicate extractive principles of drugs quicker than heat. We should, therefore, be extremely careful not to expose this tincture to the possibility of boiling. It is true the 'Pharmacopœia' gives no instruction how to evaporate this particular preparation."

"Take a water-bath," said the Senior.

The Junior was undecided what to do.

"A water-bath," said the Proprietor, "is an arrangement by which water is put between the flame and the article to be warmed, for the purpose of keeping the temperature at a desired degree. Various apparatus, mostly of copper, have been devised for this purpose, but we can just as well improvise one. This old iron evaporating-dish, that on account of the cracked enamel is not fit for anything else, will furnish a good water-bath. We fill it partly with water and insert in it a pan with our percolate, putting three corks between the two dishes to keep the inner one from moving. As the water evaporates, these corks will be wedged between the two dishes and hold the inner one in suspension, so that it cannot sink to the bottom of the outer one. The heat of the flame is now first imparted to the water, and from there to the inner dish, and can, therefore, not warm the latter to more than 212° F.,—

that is, the boiling-point of water. But by putting a thermometer in the tincture and watching the temperature, we can easily regulate the latter by either turning the gas lower or by adding occasionally a little cold water to the bath. Instead of a water-bath, a sand-bath is occasionally used by placing the evaporating-dish on a pan with sand, thereby reducing the intense heat of the flame."

"I remember," said the Junior, "of having read about an oil-bath. For what purpose is that used?"

"From what I told you," said the Proprietor, "you will see that the highest temperature obtainable for the inner dish is the boiling-point of the liquid which surrounds it, in our case 212° F., or 100° C., as we use water. The boiling-point of different liquids varies, being, for instance, 78° C. for alcohol, 103° for a solution of salt in water, 165° for glycerin, and 170° for oil of turpentine. If it is, therefore, desired to keep an article at a fixed temperature, we ascertain what liquid will boil at that temperature and use it as a bath. In this way we can speak of oil-baths, alcohol-baths, and so on; in pharmacy, however, no other baths than water-baths are generally used."

As the Proprietor stopped in his explanations without preparing the desired water-bath himself, contrary to his habit of always accompanying an instruction by practical demonstration, the Junior asked, somewhat impatiently: "Shall I prepare the water-bath?"

"Not yet," said his Preceptor. "In evaporating this percolate to a soft extract what do we drive off by heat?"

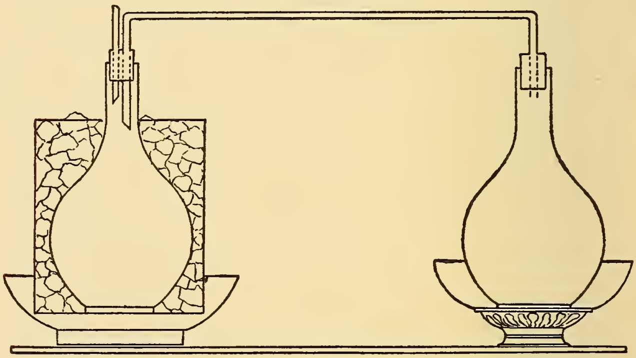
"Alcohol and water," was the reply.

"Certainly, and alcohol is a valuable article, worth being recovered. We should, therefore, for economy's sake, put this liquid in a still, or so-called alcohol reclaimer, of which various kinds are in use, the best one being the one recommended by Professor Remington in his book on 'Pharmacy.' But in the absence of a regular still we can easily prepare one ourselves."

So saying, he took two Florence flasks of the capacity of two quarts, and fitted into the neck of each one a perforated rubber stopper. A glass tube of the size of the perforation was then held into a gas-flame, and, after being moved about a short while, bent at a right angle, at about six inches from the end. The other end was then treated in the same way. Both ends of this tube were now inserted into the two perforated corks, and, after pouring the percolate into one of the bottles, both stoppers were tightly put on the bottles, so that the glass tube formed a connection between them. The cork of the empty flask was provided with a second perforation, through which a small glass tube passed, serving as a safety-valve. The filled bottle was now put in the pan with the water-bath, which stood on the gas-stove, and the other bottle in a round tin pail of convenient size, which again was put into an empty evaporating-pan similar to the first one. The empty Florence flask was then tied down to the bottom of the pail, cold water poured into the latter and small pieces of ice packed around the bottle. A possible overflow was caught up in the large evaporating-dish.

"There," said the Proprietor, "we have a home-made still, inexpensive, but perfectly serviceable. Light the gas now."

Fig. 2.



The Junior did so, and after a while the alcohol and water commenced to evaporate out of the percolate, the vapors passed through the glass tube and, on reaching the cooled receiver, condensed quickly.

"Are all fluid extracts made in this way?" asked the Junior.

"The principle is the same with all," replied the Proprietor, "although the menstruum varies greatly, ranging from pure water, in the case of chestnut leaves and couch-grass, to pure alcohol. Generally the amount of alcohol is predominating, often glycerin is added, sometimes acetic acid, and sometimes ammonia water. It would be a good study for you to find the reasons, why and where these various additions are made. But in all cases the first percolate is put aside and the remainder—sometimes a considerable quantity—evaporated to a soft extract. In doing this the heat must in most cases not rise beyond 50° C. or 122° F., while in some, like ours here, a higher temperature is permissible. Seeing the process of distillation before you, can you give me a definition of the word?"

After a moment's thinking, the Junior replied: "Distillation is the process of evaporating a liquid, conducting the vapors into another vessel, and condensing them by means of low temperature."

"And what is the object of distillation?"

"To take away the liquid," said the Junior, "and thereby gain a solid extract."

"Your definition fits the operation before you. Sometimes a more volatile liquid is separated from a less volatile one. In most cases the distilled liquid is the product desired, as in distilling alcohol from grain; sometimes the solid residue is wanted, although in that case simple evaporation can be resorted to; sometimes, as here, both the distilled part and the residue are preserved. Can we distil solids as we do liquids?"

"I do not think so," was the answer.

"There are some solids," continued the Proprietor, "that will, on heating, pass into a gaseous state without first becoming liquid, as is generally the case, and others that, when liquefied, quickly become gaseous by a slight rise of temperature, and whose vapors can be condensed again to powder. The process of doing this is called "sublimation," from a Latin word, meaning "carrying over." Sulphur is gained in this way from the ore, and we speak, therefore, of sublimed sulphur. In the preparation of calomel sublimation is employed, and ammonium chloride can be purified by the same process. But let us now return to our fluid extract."

"How can you tell when enough of the liquid has distilled over?" asked the Junior.

The Proprietor replied: "Experience alone will tell you. Our preparation has nearly reached that point."

"The 'Pharmacopœia' says: 'Evaporate to a soft extract,' while the contents of the flask are very liquid," interposed the Junior.

"They are so," replied the Proprietor, "on account of the heat. If we allow them to cool, a soft, thick extract would be the result. I now stop the distillation and take the apparatus apart. Before the extract cools, we now pour some of the reserved portion into it and mix the two liquids. Then we pour all together, and if not quite fifteen hundred cubic centimetres, add enough of diluted alcohol to make this quantity."

"Is it now ready for use?"

"Not yet. Nearly all fluid extracts will form a deposit on standing, and should be filtered before being used. As we do not need this one at once we will put it aside for a month or two."

"If we had kept the soft extract alone, would it have been a solid extract of cascara sagrada?" asked the Junior.

"As there is no solid extract official, we might prepare it by evaporating the fluid extract at a low temperature. As a matter of fact, only one official solid extract is made in that way,—the extract of ergot."

"How are the extracts generally made?" asked the Junior.

"To give a general formula," said the Proprietor, "is almost impossible, as there is a great deal of diversity in their preparation. The *modus operandi* is uniform only in so far as the drugs are exhausted in a percolator and the liquid evaporated to the proper consistency. The menstruum ranges from pure alcohol, as in aconite and cannabis indica, through all stages of mixtures of alcohol and water to pure water, as in opium, gentian, dandelion, and some others. Generally the amount of alcohol is predominant. In some cases acetic acid is added to the menstruum,—for instance, in colchicum root and conium,—and some ammonia water is used in the case of purified extract of liquorice. Most extracts are of a pillular consistence, but a few, like aloes, krameria, and colocynth, are evaporated to dryness and appear in powdered form."

"How can you tell that the extracts are always of the same strength?" asked the inquisitive young man.

"The truth is, we generally cannot tell," answered the Proprietor. "Even if we suppose that the complicated procedure of preparing them is always done with the same perfection and exactness, and the resulting extract of the same physical appearance, we have no proof of its uniformity as a remedial agent. Take, for instance, the extract of digitalis. How do we know that the leaves, bought at different seasons, from different jobbers, being of uncertain age, and coming, probably, from different sources, contain always the same amount of digitalin and other active principles, the dose of which is so small that even a slight variation in their quantity would produce different results."

"Why can we not assay them all, as we do the nux vomica and opium," asked the Senior.

"To standardize all our pharmaceutical preparations," said the Proprietor, "not only the extracts, but also the tinctures and liquors and fluid extracts, is one of the tasks of future education and research. At present the methods to do so are limited to a few drugs,—those that you mentioned and some others; but there is no doubt that further progress will be made in this direction, and our 'Pharmacopœia' will before long contain directions for assaying and testing every preparation on our shelves. Some wholesale houses have already commenced to offer assayed drugs for percolation, adopting a standard of their own wherever no official strength is given. Only after such standardization becomes general can we think of adopting official doses in our 'Pharmacopœia.'

"From the mode of preparing fluid and solid extracts you will see that they both are concentrated preparations. The former are made according to a fixed principle, each centimetre of the fluid representing a gramme of the drug, while the latter vary in this respect. The dose of both is, therefore, smaller than that of most other preparations of the same drug. Speaking of extracts, I may add that the active parts of some drugs are not soluble in either alcohol or water, and must be extracted by other solvents, like ether or benzin. The former is generally employed. These extracts are called oleoresins, and consist, as the name implies, of oil holding resin in solution. They are mostly thick liquids, and will not decompose on keeping. Their preparation is the same as that of solid extracts, using ether as solvent; but, owing to the great volatility of the ether and the inflammability of its vapors, great care is required in their preparation, and pharmacists, as a rule, prefer to buy them, especially as only small quantities are used. Now use the next half-hour looking up the various extracts and oleoresins of the 'Pharmacopœia.'"

With these words he turned towards the store.

"I tell you," said the Junior, after a while, "I commence to like the old man. At first I did not care much for this position; and, after I had been here two days, I thought of leaving."

"Why, what was the matter?" asked the Senior.

"Well, you see I must here do lots of things that anywhere else they don't ask me to do. And there is no fooling or idling around, but solid work from morning to night. But, then, after you get used to it, it does not seem so hard, and you find out that you are not only doing every-day drudgery, but learning a good deal."

"Certainly," said the Senior; "you learn more here in four weeks than you do in most stores in a year."

"That's just what I think," replied the Junior. "In my former position I did nothing all summer but sell soda-water, and I do not think that they had a percolator in the house. Every tincture was made from fluid extracts. Here you are shown everything and told how to do it, and why it should be so done."

"Yes," continued the Senior, "and you feel that the old man takes an interest in you and enjoys teaching you, even if he does get mad sometimes."

"That is another thing I like about him," said the Junior. "If anything is wrong, he just tells you; and he does it in such a quiet and decided way that you feel he is right, and you've got to shut up. And after that he is just as pleasant as before. Now, I remember a boss who would call you names and growl at you for three or four days, and take every chance to pick at you and make you feel uncomfortable and sheepish.

That is not the way to get the most work out of a fellow. I used to think that pharmacy was the worst business of any, and that I had been a fool to go into it; but since I am here I really like it."

"And that," rejoined the Senior, "is the only way to success, as our Preceptor often says: 'Love your work and you will prosper.'"

CHAPTER VI.

THE OFFICE—ORDER—DIRECTORY OF SUNDRIES—ADVERTISING AMONG PHYSICIANS.

MEANWHILE, the Proprietor had gone to the rear part of the store,—into his "office." This consisted of a writing-desk and chair near a side window, arranged in such a way that, by expanding a folding screen, it could be separated from the rest of the store. Here he spent an hour every morning,—to look over his mail, attend to his correspondence, and arrange his books. The nearness of this nook to the business part of the store enabled him to notice what was going on there, and whenever his presence was needed there was no delay in his appearance. The same system and order that we observed in his pharmacy also characterized this little "office." Each letter of inquiry was promptly answered the same day and each paper put into its proper pigeon-hole. Invoices, statements, receipts, all the papers had their fixed places and could quickly be found and referred to. In his financial affairs he was strict and punctual. Not satisfied with a simple cash-book, such as is found in many drug-stores as the only effort in book-keeping, he kept his books on the double-entry system and prepared a trial-balance every month. At the end of every six months the whole stock was overhauled and a regular balance-sheet prepared. By this method he was enabled to say with precision how much profit there was in each month; mistakes in overstocking were at once detected, expenses kept within their proper limits, and, in times of financial crisis, precautions in distributing the available funds were taken in time. A valuable book of reference with him was a small "directory of sundries," as he called it. In this directory was entered everything that came to his notice worth remembering in connection with the conduct of his pharmacy. The numerous trade circulars and advertising pamphlets that are daily offered in every store were looked over, and each new article offered for sale noted, together with the name and address of the seller or manufacturer; while the latter was entered again under a separate heading. The titles of new and old books, and the names of their authors and publishers, also found a place here, as well as the addresses of other persons that it might be useful to remember. That directory, having been kept for many years, became a suggestive history of his business and a surprisingly rich source of information.

"This book," said the Proprietor to a friend, who happened to see it, "is a dearer friend to me than I can express. To you or any other observer it is nothing but an index of names and things; but to me it is an esteemed companion, a silent reminder of my errors, a true mirror of my actions and achievements. Many entries, it is true, are of only temporary interest, becoming useless after a while; but others recall to my mind incidents and occurrences of the greatest importance or teach me valuable lessons. For instance, look here at this entry of about ten years ago. Capital was wanted for an improved machine for manufacturing certain chemicals. I thought there was a chance for me; I invested a great deal of money in it; I worried over it, exhausted my energy, neglected my business; and, finally, the whole scheme turned out a total failure. I lost much; but I learned the valuable lesson that the only safe way to succeed is to concentrate energy, ability, and capital on one business, and to let alone enterprises that are foreign to our domain, however promising they may appear. Now look at this page of the index to the book. We see the word 'Suppository,' and behind it a row of numbers, each denoting a page of the book on which the description of some suppository machine, or some other remark relating to the subject, can be found. Suppose I wish to buy a new machine. In an instant I have a series of notes before me, and can form an intelligent idea as to which to select. Looking over the pages of such a directory is as instructive as it is interesting, and, considering that all such information can be gathered without the least expense and hardly any sacrifice of time, it is certainly astonishing that not every business-man has such a book."

On this particular morning the Proprietor, after quickly disposing of his correspondence, was engaged in reading a number of type-written copies of a letter that he had prepared as an advertising circular to the physicians of the neighborhood. Proper advertising was considered by him one of the main elements of a successful business. But while many retailers recognize the importance of advertising before the public, they often forget those who should be first informed on everything new and valuable in pharmacy,—the physicians. The correctness of this plan has long been acknowledged by the manufacturers of all kinds of medicinal compounds, be they official preparations, newly discovered combinations of old drugs, or new remedies. As a rule, little attention is paid by this class of advertisers to the retail pharmacists. Their salesmen canvass only among the doctors, and persuade these to order from the pharmacist—or to buy and dispense themselves—the various ready-made preparations. Thus is the last and strongest column that supports pharmacy—the preparing of prescriptions—slowly undermined and threatened with collapse, and with it the whole structure.

To counteract this evil influence our Pharmacist adopted the same plan as the manufacturer,—sending the physicians, once a month, samples of preparations of the "Pharmacopœia" or National Formulary (such as emulsions, elixirs, medicated syrups, suppositories, pills, or capsules). Or he selected fine specimens of some drug, with all the official preparations made from it. For instance, he would take cinchona, neatly arranging in a box the different barks, whole and powdered; the extracts, fluid extracts, and tinctures, the alkaloids, pills, and elixirs. Each set of samples was accompanied by a letter, explaining and describing the drug, and setting forth, in a short, decisive way, the reasons why physicians should order the official preparations in preference to the semi-patents. By this method he had succeeded, in times of waning prescription trade, in not only completely maintaining his prescription business, but even in progressively increasing the same from year to year. For the forthcoming circular he had selected the "hypophosphites" as the subject of the advertisement, and had hardly finished reading a copy of the circular when an old friend of his, a physician, entered the office. Living in different parts of the city, as they did, the two friends did not see each other often; but all the more cordial was their occasional meeting. After the interchange of greetings, the Pharmacist said:

"I was just occupying myself with your *confrères* in my neighborhood, to whom I send advertising circulars every month."

The Doctor took the paper and read:

"Dr. Blank:

"Dear Sir,—The undersigned begs leave to send you two samples of syrups of hypophosphites, one of which, marked 'A,' contains, in each teaspoonful,—$2\frac{1}{2}$ grains calcium hypophosphite, 1 grain sodium hypophosphite, and 1 grain potassium hypophosphite.

"The other, marked 'B,' contains, in addition to the above,—$\frac{1}{8}$ grain iron hypophosphite, $\frac{1}{8}$ grain manganese hypophosphite, $\frac{1}{16}$ grain quinine hypophosphite, and $1\frac{1}{4}$ minims tincture of nux vomica.

"Other ingredients could be added, if desired, or the proportions could be changed. The syrups are flavored with essence of lemon, but any other flavor might be used instead.

"In submitting these samples I do not claim for them any superiority over similar preparations made by men experienced in pharmaceutical manipulations; but I do maintain that they are not inferior to any of the numerous syrups of the hypophosphites offered to the medical and pharmaceutical professions by large manufacturing firms. My products contain the exact stated amount of each ingredient, and are prepared as palatable and pleasant as the nature and dose of each chemical will permit.

"I am well aware that the agents of large manufacturers of similar compounds, which are offered to the trade under various protected names, try to induce the medical profession to use and prescribe their preparations in preference to those of the 'Pharmacopœia,' thereby injuring the individual pharmacist to whom your prescription might be taken, and also the pharmaceutical profession at large, by subordinating it to a mere commercial enterprise. I cannot, of course, refute all the arguments that are brought forward at such an interview without having been present; but I beg leave to show you that my own preparations are not inferior to any other in regard to purity and price.

"The chemicals in my syrup of hypophosphites are the purest made; no others are used, and no higher degree of purity can, therefore, be obtained.

"Pharmacists are often accused of substituting inferior drugs for pure ones, in order to save a few pennies. Let us suppose—for the sake of argument only, for I dispute the assertion—that human weakness is liable to yield to such temptation. Why should not the man who prepares thousands of gallons of a prescription yield just as readily as the man who prepares only one gallon? In fact, he would yield sooner, because the motive to do so—namely, the possible gain—is much greater. But I deny that the honest pharmacist will substitute, whether he prepares large or small quantities, and I use this argument only to show how effectively it can be turned against those who are only too ready to offer it.

"The retail pharmacist is frequently also accused of charging exorbitant prices for his preparations. Nothing is easier than to figure out the cost of the material and compare it with the selling price. A bottle of one of the best known syrups of the hypophosphites, similar to my sample 'B,' costs, figuring after the formula on the wrapper and taking the prices of the chemicals from one of the latest price-lists, about nineteen cents, and thus, with the bottle, label, etc., about twenty-five cents. This price is based on small purchases, such as are made by retailers; but, since the manufacturers justly claim that they can buy considerably cheaper than the retailer, a pint of syrup, including bottle, label, etc., costs them probably not more than twenty cents. For this article they charge the physician or pharmacist eleven dollars and fifty cents a dozen, or ninety-six cents a bottle, whereas I will gladly furnish you a similar article for fifty cents. Who, then, charges exorbitant prices? The pharmacist, who sells for fifty cents what costs him twenty-five, or the manufacturer, who sells for ninety-six cents what costs him twenty?

"I trust that you will kindly weigh the arguments set forth in this letter and give the products of my own laboratory a fair trial.

"Very respectfully,

"—— ——."

"What do you think of the letter?" asked the Proprietor.

The Physician replied: "I cannot but admire your enterprise and commend this idea. Such information and admonition are very useful and beneficial to many physicians, and may tend to recall them from the wrong path. One thing is certain. If the present trend of pharmacy and medicine continues, and the animosity existing in most cities between the two professions increases, we will soon see a revolution in both. Pharmacy will be reduced to a mere trade in commodities; medicine will become a menial servant of manufacturers of ready-made medicines. But let us hope for a satisfactory outcome of this period of transmutation."

CHAPTER VII.

CLEANING BOTTLES — CRYSTALS — EXPANSION—BAROMETER—BENZIN AND NAPHTHA—GIVING INFORMATION—DISPLACEMENT—ABSTRACT KNOWLEDGE AND PRACTICAL APPLICATION.

In the rear of the laboratory a small boy—engaged for cleaning, sweeping, running errands, and other menial work—was vainly trying to clean a half-gallon bottle, at which he had been working for some time; and, showing it to the Junior, he asked: "How can I get this bottle clean? There is a thick layer of crystallized sugar in it, that will not dissolve in water. I also tried to run a stiff wire through the crystals; but they are so hard and firm that I cannot break them. What can I do with it?"

The Junior meditated awhile, and then said, with an air of superior knowledge: "Don't you know that boiling water will dissolve sugar quicker than cold water? Well, then, use boiling water."

At this moment the Proprietor entered the laboratory, and, hearing the last words, took the bottle out of the hands of the boy. After examining it, he said: "A bottle with a layer of crystals seems to be an object deserving little notice, and yet we can learn a great deal from it. Many teachers—and among them even professors in colleges—think that the laws of nature can be demonstrated and explained only with the aid of expensive and complicated apparatus; but nature herself provides in her works nearly all the apparatus that we need for demonstrating her laws, and whatever we construct in imitation or explanation thereof should be of the utmost simplicity. Let us, in this sense, use this bottle and its contents, and see what we can learn from it. In the first place, how did this thick and hard layer of crystals get in there?"

When nobody answered, he continued: "Where did you get the bottle?"

The boy replied: "I found it in the cellar, on the shelf near the steam-pipe that feeds the radiators."

"Exactly," replied the Proprietor. "On account of the heat radiating from the pipe I wanted that shelf to be used only for storing empty bottles and cans that are at convenient times to be returned to the wholesalers; but some careless young man put this bottle, partly filled with syrup of tolu,—as we can tell by the odor,—on the shelf, instead of putting it in its right place. It has stood there probably the whole winter, and all the water has gradually evaporated, thereby depositing the sugar at the bottom in solid crystals so intimately connected that it is almost impossible to break them loose; they are, indeed, 'rock' candy. What is a crystal?"

"Oh," said the Junior, "that is an easy one. A crystal is—is—for instance, the diamond is a crystal; it has smooth sides and sharp corners."

"How do the sides—or faces, as they are properly called—meet?"

"In straight lines."

"Edges we call them. We therefore have this definition of a crystal: 'It is a self-shaped, regular solid, with smooth, level faces, meeting in straight edges, thereby forming perfect corners and angles.' You can see a fine crystal of sugar in the middle of the layer in this bottle. Can you count the faces?"

"Yes," said the boy, "I can see three at a glance, and two more behind when I turn the bottle, and one on which it lies, makes six. It looks like a die."

"No, not like a die," said the Junior, "for it is out of square."

"You mean," added the Proprietor, "that the faces do not meet at right angles. The crystal is an oblique, four-sided prism."

"Are there not many different shapes of crystals?" asked the Junior.

"Certainly, there is a great diversity. But they all follow certain laws in their formation, and each chemical substance has its definite form of crystallization. The science of classifying and describing crystals is called crystallography, and is a very interesting part of the applied mathematics. It is of great importance in physics and chemistry, and every pharmacist should understand at least its fundamental laws. In its practical application, crystallography teaches us how to distinguish between the various minerals, salts, and other crystalline bodies. You will learn more of it later, at college. Let us return to our bottle. How will we get this solid mass of crystals, that have firmly grown together, out of it without waiting, perhaps, a whole day for their solution in water?"

"I told him to use boiling water," said the Junior.

"Heat will, of course, accelerate solution," replied the Proprietor; "but is there no danger in pouring boiling water into this bottle?"

"It will crack," said the boy.

"Yes; and why will it crack?"

The two young people looked at each other in surprise. As if everybody did not know that boiling water was apt to crack a glass or bottle! It seemed to them amusing to be asked such a question. The Proprietor read their thoughts from their faces, and continued:

"To explain the cracking of a bottle by suddenly heating or cooling it requires the knowledge of several natural laws. In the first place, you should know that heat expands all bodies,—that is, they will occupy more space. Look, in different seasons, at the joints between the ends of the single rails of a railroad, and you will notice in winter a clear space between them, whereas in summer they about touch each other. When the builders of the road put the rails down, they took into consideration the temperature of the season, and took care to leave them sufficient liberty to expand in hot weather or contract in colder, and this precaution is taken in other iron structures, such as bridges."

"Oh, I see," exclaimed the Junior; "that is why the iron structure of the New York and Brooklyn bridge has an open space in the middle, covered by a sliding-plate."

"Exactly," replied the Proprietor. "In summer this space is lessened, as the two central ends of the framework slide together. The difference of expansion on each of the three spans of that bridge, between the hottest and coldest days of the year, amounts to several inches. Now apply this to our bottle. The boiling water would suddenly heat the glass and cause it to expand."

"But why should it crack on that account?"

"It does not expand evenly; at least not at once. If one part or side of a thing is heated, it does not follow that all the other parts or sides must speedily become equally hot. The property of conducting a change of temperature from one part of their mass to another is possessed in very different degrees by different substances. Metals are good conductors of heat, as you can see when you put a teaspoon into a cup of hot coffee. The handle of the spoon becomes hot very quickly, although it is not immersed in the coffee; because the heat applied to the other half of the spoon is quickly distributed through the whole mass of the metal. If, in place of the spoon, you were to stir your coffee with a glass rod, you would be able to hold the upper end for quite a long time without feeling any heat, although the end dipped in the liquid would soon be hot; for glass is a poor 'conductor' of heat. Wood, porcelain, and cloth are also bad conductors, and are therefore used for making or covering the handles of metal dishes or cooking utensils. In the case of our bottle this slow passage of the heat through the substance of the glass works destruction. The inner surface of the bottle becomes suddenly hot and expands, but the outer part remains cold, and the consequence is that the glass tears or cracks, because it cannot bend to accommodate its shape to this one-sided expansion."

"So I must not use hot water?" asked the boy.

"You might, but in the proper way. You would have to warm the water gradually, so as to give the heat time to pass through the whole mass before any one part can expand much. This can be done quite safely by either pouring into it a number of portions of water of different temperatures, each successive portion being a little warmer than the preceding one, or, better, by a water-bath. But in our case there is another and a better way of dissolving this sugar quickly without the aid of heat. Observe my movements. First, I take any convenient vessel, larger in diameter than the bottle,—for instance, this wash-basin,—and, covering its bottom with a few inches of water, put it in a level position. I now fill the bottle with water to the very top of the neck, cautiously dropping in the last drops, so as to be sure that no space will remain over the water. Next I take a smooth piece of paper—for instance, this small powder-paper—and lay it closely across the top of the bottle, closing it thereby. I now carefully turn the bottle upside down, while holding the paper in its place. You will see that the paper does not fall off when I now remove the hand which held it in place, and that none of the water runs out of the bottle. The inverted bottle is put in the wash-basin, where we have it standing on its head. No further work is necessary; in a very short time all the sugar will be dissolved."

The boy looked on in surprise, and said;

"I do not understand why the water did not run out of the bottle when you turned it over; it certainly could have pushed the paper aside."

"It could not in this instance, for the atmospheric pressure—that is, the counter-weight of a column of air as high as our atmosphere—kept it in its place. As long as no air was allowed to enter the bottle and take the place of the water, the latter could not get out. Do you know an instrument that depends on this same atmospheric pressure for its operations?"

"Yes, sir," replied the Junior: "the barometer."

At this moment the Senior entered and told the Proprietor that a customer wished to see him. The Proprietor went into the store, where an excited lady, one of his regular customers, was waiting for him.

Without further formality, she said :

"I was here half an hour ago, and asked for some naphtha to clean my gloves. At home I found that the young man had given me benzin. Now, this same mistake has been made in other stores, where they subsequently told me that benzin and naphtha were the same thing. But I know better. I want naphtha. If you have none, say so ; but do not give me what I do not want. Benzin may be good enough for some things, but I do not want it." She put a small package on the counter and pushed it indignantly towards the Proprietor.

"I will rectify the mistake," he said, quietly, taking the bottle and walking with it into the laboratory. After scraping off the printed label "Benzin," and replacing it by a written one, reading "Naphtha," he returned to the store, and proceeded to wrap the same bottle in paper.

"Let me smell it," said the customer, taking the bottle out of his hand ; and, after pulling the cork, held it to her nose. Then she said, with an air of satisfaction : "Yes, that smells quite different ; that *is* naphtha. I am very particular about my white gloves, and know that naphtha will clean them better than benzin."

"I am very sorry that you were inconvenienced, madam," said the Proprietor.

"Oh, that does not matter ; I am much obliged," she replied, and left the store with a sweet smile.

Behind the perscription-counter, meanwhile, the Manager grinned, with a decided "I-told-you-so" air, at the Senior, who was in doubt whether he should be wroth or amused.

"You should label every article," said the Proprietor, "in such cases of synonymous names, with the name by which it is asked for. We know that in ordinary drug commerce the names 'benzin' and 'naphtha' are used indiscriminately for a certain grade of petroleum oil, or something pretty close to it, which is usually the only grade of that kind of goods kept in retail drug-stores. It is a somewhat indefinite mixture of several light hydrocarbons, and should not be confounded with 'benzene' or 'benzol,'—a definite hydrocarbon of another kind, gained from coal-gas tar. But many people, nevertheless, think that 'benzin' and 'naphtha' designate substantially different articles, of different cleansing properties."

"But why did you not tell her," remonstrated the Senior, "that both were the same? Is it not our duty to enlighten the public?"

The Proprietor replied: "If that lady had been my clerk, or if she had asked me about the two words, I should certainly have enlightened her. But her confidence in her own superior knowledge is so firm, that it is better to humor her and see her go home pleased than to try to give an explanation, which we know she will not believe. If any danger, or even inconvenience, might have been caused by her error, I would certainly have acted differently. However, to give undesired information, which is apt to place the receiver in a ridiculous position, is, from a business stand-point, a very foolish thing to do. I need not tell you that I value the professional side of pharmacy much higher than its commercial side; but, as long as, for the sake of self-preservation, we are compelled to be tradesmen also, let us not exhibit our professional standing in cases where it will do no good, but will drive our customers away by offending their vanity. If they insist on being ignorant, let them be so. My experience, sharpened by the occasional loss of a customer in former years, has taught me the wisdom of such action in many cases, and this was one of the cases."

After these words he returned to the laboratory, where he found the boy and the Junior examining the inverted sugar-clogged bottle with evidently pleasing surprise.

"What are you looking at?" he asked.

"Why," said the Junior, "we can see how the sugar, dissolving in the water, is descending through the bottle in long streaks."

"This process," explained the Proprietor, "is called circulatory displacement, because the top portion of the liquid, after dissolving some of the sugar, and thereby becoming heavier, sinks to the bottom, being displaced by another portion, which in turn goes through the same process; and by this continuous displacement a constant circulation in the entire mass of the liquid is produced. Thus the sugar will be dissolved very quickly, without any shaking or heating."

"I am glad you showed us this," said the Senior, who had followed the Proprietor into the laboratory. "Of course, I knew something about 'circulatory displacement,' but I should never have thought of using it for cleaning a bottle."

"You will see, then," replied the Proprietor, "that a mere abstract study of the laws of nature—or, speaking more generally, all purely theoretical knowledge—will serve us but little, however pleasing and elevating its possession may be. The world has greatly changed in this respect. There was a time when science was looked upon as something wholly distinct from and raised above the ordinary every-day interests of humanity; the scientist's only aim and ambition was to learn, expound, and interpret, or, as Immanuel Kant expressed it so grandly, 'to conceive the Creator's thoughts after him.' To seek worldly gain and reward was below his level, and some of the most eminent men of learning, in former centuries, lived in poverty, while they left to posterity an illimitable treasure of ideas. How different is it to-day! Every law of nature, every newly discovered fact or force, is at once pressed into service and utilized for gain. Mere theories are hardly considered; whatever cannot be turned to immediate utility is not thought worth knowing, and amounts to nothing in the estimation of our age. Ours is a practical epoch, and never before was the direction of research so bent on practical application as now. One wonderful invention surpasses the other, and thousands of restless brains are working day and night to outdo each other in new and momentous results."

"There, now!" exclaimed the boy; "the last piece is gone."

The Proprietor and Senior turned around, and saw how the boy, with radiant face, lifted the bottle out of the wash-basin, pouring out the water, which had meanwhile dissolved all the sugar.

CHAPTER VIII.

INFUSION-JAR — EMPTIES — CLEANING BOTTLES — ECONOMY—INFUSUM DIGITALIS—OLD-FASHIONED PRESCRIPTIONS—NON-LUMINOUS FLAMES—DECOCTIONS—LATIN PRESCRIPTIONS—STRAINERS.

THE Proprietor continued: "We often make use of this same process in preparing infusions,—that is, solutions of the soluble parts of vegetable drugs in hot or cold water, without ebullition. Bring in our new jar."

The Junior took from the shelf a cylindrical implement, containing a small colander hanging at the end of a long stick.

"The ordinary infusion-jar," said the Proprietor, "is a most unpractical instrument, the drugs generally resting on the bottom, and to make a good infusion repeated stirring and straining is necessary. Another apparatus has been proposed, consisting of a porcelain jar into which a colander—that is, a vessel with a perforated bottom—fits closely. While this second article is superior to the first, it has the disadvantage of being only of a certain, fixed measure, as, for instance, a pint, and any smaller quantity of infusion cannot be prepared in it. Now, in most cases where extemporaneous preparations of infusions are required, as in prescriptions, only a part of a pint is wanted.

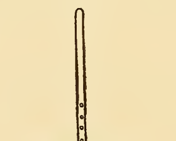
For instance, in this prescription, which was left here awhile ago, to be called for to-night."

He went to the prescription-counter, and returned with the following:

> ℞ Sodii Bromidi,
> Ammonii Bromidi, āā ʒii;
> Infusi Quassiæ, q. s. ad f℥vi.
> M. Sig.—f℥ss at night.

"Let me first show you my infusion apparatus. It consists of five parts. The first is a cylindrical graduate holding one pint. The second is a wooden cover with a hole in the centre. The third is a hollow glass cylinder, two inches deep, fitting into the graduate, its lower end covered by a piece of so-called cheese-cloth, which is firmly tied around it; its upper end supported at two points by a string, to which a stick is attached, transversely perforated, at intervals of half an inch, with small holes, and of such a size that it will slide through the hole in the cover. The fourth part is a wooden pin, fitting into any of the perforations of the stick. The fifth part is a glass or porcelain disk with a number of perforations. Now, let us see how it works.

Fig. 3.



Six fluidounces of infusion are required. I pour six ounces of water into the graduate. Infusum quassiæ is not an official preparation, and we might therefore use the general formula for infusions not specially directed, as given in our 'Pharmacopœia,' which prescribes for such a common strength of five per cent. The British 'Pharmacopœia,' however, has an official infusion of quassia, using fifty-five grains of the wood to ten fluidounces of cold water, which is a little over one per cent. Fortunately, I know that the physician ordering this prescription is an Englishman, who wishes all his prescriptions prepared according to the British 'Pharmacopœia.' Without commenting upon the propriety of setting up such a standard in this country, we will proceed to prepare the infusion according to the British formula. For our six fluidounces we need six-tenths of fifty-five grains, or thirty-three grains of quassia."

After weighing the desired quantity, he put it on the cloth of the small cylinder and covered it with the circular piece of glass.

"This piece of glass," he said, "is here used for keeping the quassia chips under water, thereby insuring a more thorough exhaustion of the drug. I now slip this wooden rod through the hole in the cover, let the cover rest on the graduate, and, by means of the rod, arrange the small vessel in such a way that the water will just cover the drug. Finally, I put this little wooden pin through that hole in the rod which is next above the cover, to hold the rod in position. The rest explains itself. After the apparatus has thus stood the required length of time, we lift the inner part out of the graduate, and the clear infusion is ready, no straining or filtering being necessary. In our case we might also put the bromides in the cylinder, and let them be dissolved in the same way as the sugar in our bottle some minutes ago."

"How did you get the small cylinder?" asked the Junior.

The Proprietor replied: "I took a small cylindrical ointment-jar, and, after heating the bottom by means of a blowpipe, plunged it suddenly into cold water. We have learned before that the result must be the cracking of the glass. If the manipulation be skilfully executed, the bottom will thereby come off the little jar neatly and cleanly. In constructing this apparatus commercially I would substitute a glass colander in place of the cylinder, so that the cheesecloth might be omitted, and also enlarge the diameter of the graduate to four inches; for in the case of a bulky drug like buchu leaves our colander is rather small."

The Proprietor went to the other end of the laboratory, where the boy, assisted by the Junior, had put a great number of cans, jars, and bottles of various sizes and shapes on a large table, for the purpose of cleaning them. These "empties" had been collected during the preceding month, and comprised a great diversity of vessels. There were the usual containers for drugs, oils, or chemicals, as sent by the wholesale dealers, and there were bottles of all sorts, brought in by customers, unfit for the intended use.

There was a pocket-flask, brought by young O'Flanigan with a prescription, and the remark, "Father said to put it in this bottle," while the prescription called for powders; there were wide-mouthed pickle- and mustard-jars, such as a little girl would lug in, asking for five cents' worth of oil of cloves; there were beer- and brandy-bottles, that had been proposed as containers for, say, a dose of castor oil. All such bottles had been exchanged by the clerks of the store for vials of proper shape and size, provided that the nature of the purchase would warrant such an exchange.

Besides these, a large number of dirty magnesia- and prescription-bottles had accumulated, and also containers of the various semi-patents that are used in dispensing.

They all stood on a shelf set apart for this purpose; for in the daily rush of business there was no time to decide upon the individual usefulness of each article, nor was it practicable to sort and clean them every day; this was done about once a month, whenever the shelf was full.

The boy, young and inexperienced, was doing the work for the first time. After watching him for a few minutes, the Proprietor said: "Your method of picking up one bottle after the other and cleaning each in turn is not a good one. You should, in the first place, assort your stock. Whenever you see the name of a wholesale firm, of whom we buy, on the label of a bottle, put it aside. Here is one that contained collodion and this one potassium citrate. We send them back to the jobber, who allows us whatever he charged for them."

The Junior interrupted him: "My former employer used to say it was not worth while to save these empties,—'the game was not worth the candle,'—and we generally threw them away."

"Let us see if this game is worth the candle," said the Proprietor. "Here is a five-gallon can, worth seventy-five cents; here are two two-gallon cans, each thirty-five cents,—makes seventy cents; here we have four one-gallon cans and demijohns, each twenty-five cents,—makes one dollar; here are three five-pint glass-stoppered bottles, at twenty-five cents each,—makes seventy-five cents; and a great number of smaller bottles, worth, together, about one dollar or more. All this, added up, makes four dollars and twenty cents at the first glance; but the amount will probably come near five dollars. Take this twelve times during the year, and you have saved from fifty to sixty dollars. We send them in old boxes, so that the packing does not cost us anything; nor does the expressage, for any expressman can easily be induced to take back empties free of charge, if he is promised all the business of the house. And even if we had to pay twenty-five cents for freight every month, it would not considerably reduce the amount."

"Yes," said the Junior, "you are right as far as such empties are concerned, for they need not be cleaned; but look at the great number of other bottles that we have to clean. Are they really worth the time and labor?"

"I certainly do not recommend," was the answer, "the cleaning of any bottle, if it costs more than the bottle is worth. But such cases are exceptions. Let me here give you a little advice in respect to economy. I have noticed that you, as well as our friend the Senior, often look surprised when I recommend the saving of small articles,—for instance, a cork, or a filter that has been used only for alcohol, or a piece of tin-foil or wrapping-paper, or some twine taken from packages delivered by the expressman, or, as now, a bottle. You know that for all of these little things I have separate places. I know where to put them, and, consequently, where to find them when needed. Now, each of these articles is very small and insignificant in itself, and yet they amount to a great deal in the course of a year. It is the same as getting a small discount of one-half or one per cent. on your purchases. Remember that the time has long passed when every article that the pharmacist touched turned to gold. To succeed to-day means to work and to save, and therefore you should never forget that in a retail drug-store there are sooner two hundred chances of saving half a cent each time than there is one chance of saving a dollar.

"Now," he continued, "let us look at our bottles again. After selecting the empties to be returned to the wholesaler, without being cleaned, we pick out such bottles as are of no use whatsoever to us,—for instance, prescription-bottles with the name of another firm blown in the glass, or empty pickle-jars and patent-medicine bottles, that some foolish customers will sometimes bring in. All these are to be put into a separate barrel, to be sold to a junk-man for whatever we can get for them. They need not be cleaned either. What is left can be used and must be cleaned. We now pick out the bottles and jars that can be cleaned with water alone. To this class belong all the bottles that contained medicated syrups or elixirs. Here, for instance, are two bottles of hypophosphites; here is an elixir of lactopeptine and two panopeptones, and many similar preparations that the pharmacist of to-day has to dispense."

"But what are you going to do with these bottles?" asked the Junior.

"They are useful for putting up benzin, Javelle water, solution of corrosive sublimate, and similar cheap articles that we have ready for sale. We can get the same price for a pint of benzin, whether contained in an old bottle of Jones's hypophosphites or in a new prescription-bottle, and we save six cents by it.

Fill these bottles with water, and then immerse them in a tub of water, so that labels and adhering syrup are loosened, and that they will be cleaned outside and inside at the same time. But here we have some bottles that contained lime water, as we see by the label, and which are coated inside with a white precipitate. How can we clean these?"

"With sand," suggested the boy, timidly.

"I know a better way," replied the Proprietor. "Whenever there is a known chemical precipitate our first question must be, What will decompose or dissolve it? If we can find a cheap solvent, let us use it and save the bottle; but, of course, if nothing but an expensive solvent, like chloroform or ether, will remove the objectionable sediment, it is better to put the bottle into the junk-barrel. This lime precipitate is calcium carbonate, formed by the action of the carbon dioxide in the air on the calcium hydrate in the solution. By using a suitable acid—say acetic or hydrochloric—we decompose the carbonate and form a soluble lime salt."

He poured a little water into the bottle and added about a drachm of commercial hydrochloric acid, saying: "See how the decomposition of the calcium carbonate takes place at once, and how the carbon dioxide is liberated in the form of small gas-bubbles, while the water dissolves the chloride of calcium formed."

"You showed us before how infusion quassia is made. Are all infusions made in the same way?" asked the Junior.

"By no means," replied the Proprietor. "Quassia forms an exception to the general rule, which requires boiling water to be poured on the drug. A similar exception is infusion of wild cherry (Infusum Pruni Virginianæ), which is likewise made by percolation with cold water. So is also the infusion of calisaya bark (Infusum Cinchonæ), in which one per cent. of aromatic sulphuric acid is added to effect better solution of the active principles of the bark. The 'black draught,' or Infusum Sennæ Compositum, is, as the name says, a mixed or compound infusion, containing, besides the soluble ingredients of senna and fennel, certain quantities of manna and of magnesium sulphate."

"Why do we not keep these infusions in stock?" asked the Junior.

"Because they will soon decompose, being made with water only, without the addition of some preserving agent. The dissolved vegetable matter will undergo fermentation and new compounds will be formed. How quickly this change happens you will observe in the common household infusions of daily use,—tea and coffee. What a change in the flavor if they are allowed to cool and then are heated again! The volatile oil, on which the fine aroma depends, is gone, and nothing is left but a bitterish, stale, extractive solution."

"If coffee and tea are infusions, it would be the wrong thing to boil them," remarked the Junior.

"Certainly," replied the Proprietor, "they should be treated as infusions. The coffee or tea should be suspended in hot water, just as I suspended the quassia in the cold water before; and then withdrawing the source of heat and applying to the infusion-vessel a tight-fitting cover, the fine aroma will be retained in the drink and not be spread all over the house. How much better it would be if these and numerous other practical appliances of physico-chemical manipulations were taught in our schools in the place of some of the fragments of theoretical science that are now presented for study, and that require an already ripened intellect for their fruitful cultivation. It is certainly more gratifying to a young husband to be refreshed in the evening by a cup of truly aromatic coffee than to be treated to a discourse of the constellations of Cassiopeia or Orion as an adjunct to stale coffee and indigestible food. But let us return to our pharmaceutical infusions. The only one that can be kept any length of time is Infusion Digitalis, which contains ten per cent. of alcohol."

The Senior, who had here entered the laboratory with an empty bottle in his hand, had overheard the last words of the Proprietor, thereupon remarking: "And yet we see on most prescriptions for digitalis infusion the direction 'make fresh,' so that we must infer that the doctors either do not know of the alcohol in the infusion or have little confidence in its preserving power."

"The cause of this," said the Proprietor, "can be found in a precipitate forming in the infusion on standing, which could easily mislead the dispenser to believe that it was the result of the decomposition of the active principles of the digitalis, whereas various examinations have definitely proved that it was caused by the cinnamon bark added to the foxglove leaves for flavoring purposes. In the present edition of the 'Pharmacopœia' this objection has been removed, cinnamon water being used in place of the bark."

And turning to the Junior, he added :

"Now, I have mentioned the four infusions of our 'Pharmacopœia' that are not made according to the general formula,—cinchona, digitalis, wild cherry, and compound senna."

"How about this one?" said the Senior, holding up the bottle he had brought in, with the label "Infusum Gentianæ Compositum."

"It is to be regretted," said the Proprietor, "that this valuable infusion, which was official in 1870, has not been reintroduced in 1890. You know that we see more of it prescribed than of any other infusion, and in making it I have always adhered to the formula of 1870, unless the British official preparation was specified. Compound infusion of gentian also contains alcohol, twelve and a half per cent., and can therefore be kept in stock. You will find the formula in the Dispensatories."

With these words he left the laboratory. The Senior took the book and read the formula. "There," he exclaimed, "gentian, orange, and coriander! Gentian comes from the mountains of Southern Europe, orange from Florida, and coriander from Italy and Germany. There was a good chance to show off; but when I knew everything he would not ask me."

After weighing the three ingredients he moistened them with a sufficient quantity of alchol and water of the required strength, and packed the whole into a percolator, following the formula of the 'Pharmacopœia' of 1870.

Returning to the store, he found the following prescription, which the Manager had just handed the Proprietor:

℞ Radicis gentianæ concisæ,
Radicis calumbæ contusi,
Corticis cinchonæ flavæ contusi,
Corticis cascarillæ contusi, ana unciam;
Capsici pulveris, drachmas duas;
Aquæ fontanæ, octarios duos.
Fiat decoctum. Ad colatum adde:
Spiritus vini rectificati, uncias quatuor;
Syrupi, quantum sufficiat ad octarios duos.
Misce, da et signa; cochleare magnum ter in die, ante cibum.

"This is an old-fashioned prescription, such as we used to see twenty-five years ago," said the Manager.

"These decoctions," replied the Proprietor, "are little used nowadays, tinctures and fluid extracts having taken their places. Their unsightly appearance, large dose, and nauseous taste, and principally their unreliable and unstable character, have brought them into disuse, much to the disadvantage of the pharmacist."

"That is a funny prescription," said the Junior; "the doctor first orders two pints of water and afterwards four fluidounces of alcohol, and enough syrup to make two pints again."

"We will see about that," answered the Proprietor, "and get the drugs together." After these had been weighed, he continued: "What shall we do with them now?"

"I suppose, powder them," suggested the Junior.

"The prescription gives us full directions in that respect. After gentian we see the word 'concisæ,' meaning 'cut;' and after the other ingredients, 'contusi,' meaning 'bruised.' We have the gentian in the desired shape; all the other drugs, except the capsicum, must be bruised in an iron mortar."

While the Junior prepared the drugs, the Proprietor put two pints of water into a half-gallon earthenware vessel, provided with a handle and cover. A tripod was quickly put on the table, and under it a Bunsen burner, attached to a gas-jet by means of a rubber tube.

"What makes the flame almost non-luminous?" asked the Junior, after the burner was lighted.

The Proprietor replied: "The gas enters the tubular burner at the lower end through a very small orifice, and would, if ignited there, burn like any other flame. But through these holes at the bottom of the burner air enters and mixes with the gas, so that, on igniting, the otherwise luminous incandescent carbon particles are at once converted by the additional oxygen into invisible carbon monoxide and dioxide, producing at the same time an intense heat. By turning this little ring, provided with four holes corresponding to those of the burner, we can regulate the access of air to the burner, and produce a luminous or non-luminous flame at will. This same principle applies to the gas-stove we use so often in our laboratory. Now put all the drugs into the pot and boil them for fifteen minutes, the time prescribed by the 'Pharmacopœia,' covering the vessel to keep the vapor over the decoction, and thereby exclude the air."

"Are there any official decoctions?" asked the Junior, and the Senior replied:

"Yes: Decoctum Cetrariæ and Decoctum Sarsaparillæ Compositum. In the case of the former, the Iceland moss is first macerated with cold water for half an hour, and this infusion thrown away, to remove the bitter taste."

"So it is," replied the Proprietor; "but thereby a great deal of the medicinal virtue is also lost, and the gain is a very doubtful one. The compound decoction of sarsaparilla, consisting of sassafras, guaiac, liquorice, and mezereum, seems to be a remnant of former barbarous pharmacy. The medicinal principles of guaiac wood are insoluble in water; those of sassafras nearly so. Liquorice is nothing but an aromatic, so that the active constituents are reduced to sarsaparilla and mezereum. Why such an unsightly and unscientific preparation should have been retained in the 'Pharmacopœia' is hard to understand."

A peculiar aromatic odor, emanating from the decoction-vessel, indicated that the boiling-point had been reached, and after the necessary time of ebullition the Junior turned the gas off and asked: "What shall I do next with it?"

The Proprietor answered: "If we were to follow the direction of the 'Pharmacopæia,' we should now let it cool to about 40° Celsius, express, and strain. But, as you see, the doctor who orders this decoction has his own idea of drugs and their preparation, and wants us to follow strictly the directions of his prescription. What does he prescribe?"

"I cannot read Latin enough," said the Junior, embarrassed.

The Proprietor replied: "If all our physicians would write prescriptions like this one, the study of Latin would soon become compulsory for students of pharmacy."

"The average doctor does not know any more Latin than the average druggist," interrupted the Senior.

"I am sorry to admit this lamentable fact," replied the Proprietor; "but the ignorance of others is no excuse for your own. 'Ad colatum' (namely, decoctum) adde' means 'to the strained decoction add;' we must therefore strain."

"Hot or cold?" asked the Junior.

"If we strained hot and added the alcohol, we would make two mistakes. First, hot water dissolves more vegetable matter than cold; the decoction, if strained hot and allowed to cool afterwards, would contain a copious, unsightly deposit. Secondly, if we added the alcohol to the hot liquid, it would mostly be driven off, for alcohol boils at 78° Celsius, or 172.4° F. For these reasons, let us allow the decoction to cool; meanwhile, get the straining-rack."

The Junior brought a small wooden frame, about a foot square, with movable sides, provided with holes through which a small wooden pin could be put. This allowed the operator to adjust the frame to any required size. Near the holes, at intervals of two inches, small pointed nails projected, on which a straining-cloth could be suspended. After adjusting the frame over an empty funnel inserted into a two-pint prescription-bottle, and soaking the cloth in water, the decoction, which had meanwhile cooled to the required temperature, was poured on the cloth.

"Why," exclaimed the Junior, "there is little more than a pint!"

"Now you see the correctness of the prescription," said the Proprietor, "in ordering the other liquids to be added. What has become of the balance of the water?"

"Well," answered the Senior, "some is lost by evaporation, and a larger part remains in the drugs on the strainer."

The Proprietor handed the Manager the prescription, saying: "We will turn this over to you to finish, and direct our attention to some other aqueous official preparations that must be made."

CHAPTER IX.

MEDICATED WATERS—ODOR IN DRUG-STORES—EMULSIONS—MUCILAGES—MEASURING OILS—NAUSEATING MIXTURES.

THE Proprietor turned to the laboratory, where a number of bottles had been put on the table.

"By 'aquæ' or 'medicated waters,' in the pharmaceutical sense," he addressed his assistants, "we understand aqueous solutions of volatile substances, of which there are seventeen in our 'Pharmacopœia,' made by five different processes,—namely, distillation, chemical decomposition, charging with gas, simple solution, and percolation through impregnated calcium phosphate. The first three processes are rarely used in an ordinary laboratory, owing to the inconvenience and expense of the necessary apparatus. The two official waters gained as a side-product in distilling the respective oils—namely, 'Aqua Aurantii' and 'Aqua Rosæ'—might also be made by dissolving the oils with the aid of calcium phosphate; or, better still, by shaking the oil in a bottle with warmed, distilled water; and I know that a number of druggists make them in that way. If good oils are used, they are not inferior to the side-products of distillation."

"What waters come under the second class,—chemical decomposition?" asked the Senior.

"Only one, a new official preparation,—solution of hydrogen dioxide (H_2O_2). It is made by decomposing barium dioxide with phosphoric acid. Barium phosphate is precipitated and filtered out, and small traces of the remaining salt are removed by sulphuric acid. The inconvenience of making this 'aqua' consists in the low temperature (below 50° F.) at which the work must be done. Aqua Chlori and Aqua Ammoniæ are made by passing the respective gases through water, but are rarely prepared in the laboratory."

"But chlorine water cannot be preserved for any length of time without deterioration," said the Senior, "even when kept in dark bottles and in a cool place."

"Very true," replied the Proprietor; "and in pharmacies where much chlorine water is used it is prepared fresh every time by a generating apparatus, such as is described in the 'Pharmacopœia.'"

Pointing to a dark, amber-colored bottle on the table, he continued: "This preparation—'Aqua Chloroformi'—is a good representative of a simple solution of a volatile substance in water. Do you know how it is made?"

The Senior replied. "By shaking chloroform with water, allowing an excess to remain in the bottle. Whenever some chloroform water is used, more distilled water is added, until all the chloroform has been dissolved."

"Very true," said the Proprietor, filling the stock-bottle again and agitating it, "and in a similar way, by simple agitation with water, 'Aqua Creosoti' and 'Aqua Amygdalæ Amaræ' are made. Now, of the last process of making medicated water, 'Aqua Menthæ Piperitæ,' which must be made to fill this stock-bottle, will serve as a good example."

Turning to the Junior, he continued: "Take a large mortar. Our stock-bottle holds five pints, or about two thousand five hundred cubic centimetres. According to the formula we need ten grammes of precipitated calcium phosphate and five cubic centimetres of oil of peppermint. Put both in the mortar and triturate them well together. The object of this process is to divide the oil into innumerable minute particles, so that it will present a larger surface to the water. It is of the greatest importance to triturate thoroughly, in order to afterwards effect a perfect solution. Now add the distilled water gradually, stirring constantly, and, finally, filter. Can you tell me what other waters are made by the same process?"

"Yes, sir," answered the Senior: "'Aqua Anisi,' 'Aqua Fœniculi,' and 'Aqua Menthæ Viridis.' In the case of camphor water, a small portion of alcohol is used to powder the camphor before mixing it with the calcium phosphate."

While the Junior proceeded to prepare the peppermint water, the Proprietor returned to the store to wait on some customers.

"What a lovely odor there always is in your store!" said a lady who had just entered. "How do you bring it about?"

"Without the least effort or intention," answered the Proprietor; "we make all our preparations in the laboratory behind the store. At present the clerk is preparing peppermint water."

"Do you know," said the lady to a friend who had come in with her, "that this agreeable odor always reminds me of a description that I once read of Solomon's Temple? It was stated that the mortar used in building the Temple was mixed with an exquisite rare perfume, the odor of which afterwards prevailed in the Temple. Nowhere else was this delicate odor found, and its presence there at once invited the comer to worship and devotion. In the same way, how much pleasanter is this agreeable odor of drugs than the smell of tobacco or, what is worse, of liquor, such as we sometimes meet in ill-conducted pharmacies! It not only bids you welcome, but makes you feel that you are in the right place, and fills you with confidence in the pharmacist."

Turning to the Proprietor and handing him a prescription, the customer continued: "Will you kindly send this medicine to the house? I will not be back for some time and the patient needs it sooner. Send also a bottle of your emulsion of cod-liver oil with hypophosphites. We formerly used a proprietary article, but our physician recommended yours as being just as reliable and, besides, a good deal cheaper. It is the one of which you sent him a sample last month."

After the customer had left, the Proprietor returned to his clerks and showed them the following prescription:

℞ Ol. Ricini, ʒiv;
Mucil. Acaciæ, ℥i;
Syr. Tolut., ℥ss;
Aq. Gaultheriæ, q. s. ad ℥iii.

"This prescription," he said, "brings us to two other classes of official preparations,—the mucilages and the emulsions. The latter were formerly treated under the general heading of Misturæ, and I consider it fortunate that the revisers of our 'Pharmacopœia' have adopted a more accurate classification."

"But there is no official emulsion ordered in this prescription," said the Junior.

"Very true," answered the Proprietor; "but the whole prescription forms an emulsion,—that is, a preparation in which oils and oleaginous substances are suspended in water by the aid of gum or some other emulsifying agents."

The Senior, wishing to show his knowledge, interposed:

"Some official emulsions, however, like Emulsion Ammoniaci and Emulsum Asafœtidæ, do not require any gum at all, the drugs being simply triturated with water."

"And why are they prepared in that simple way?" asked the Preceptor; and, receiving no answer, he continued: "Because in those two cases the drugs are natural mixtures of gum and resinous or oily matter, so that all the ingredients for an emulsion are already present. In fact, the juice of the plants is a natural emulsion, which, on exposure to the air, hardens into what we call gum. It might justly be called a vegetable milk. But the formulas for the two other official emulsions—namely, chloroform and almond emulsions—call, in the one case, for gum tragacanth, in the other, for acacia, as the intervenient suspending vehicle."

"Is it not the rule that the amount of the gum should be half that of the oil?" asked the Junior.

"Such a general rule is often given," replied the Proprietor, "and the quantity of water is then mentioned as half that of the oil and gum together. But different oils require different treatment. Castor oil, for instance, will form a good emulsion with only one-fourth, or even less, of its weight of gum. Experience is of greater importance in connection with these preparations than with any other class; therefore, whenever you prepare an emulsion, you should watch the process carefully, and remember the proportions of the ingredients and the result. But let us return to our prescription."

"We have neither mucilage of acacia nor wintergreen water," said the Senior.

The Proprietor answered: "You know that all the official mucilages—that is, solutions of some gummy substances in water—are very unstable preparations, owing to the formation of acetic acid therein; even when kept in well-corked bottles they 'sour,' as the common expression is. It is for this reason that the 'Pharmacopœia' directs two of them—namely, Mucilago Sassafras Medullæ and Mucilago Ulmi—to be freshly made when wanted, while the mucilage of tragacanth is rendered more stable by the addition of glycerin. The mucilage mostly used—Mucilago Acaciæ—also decomposes very quickly, and I therefore prefer to make it freshly whenever it is called for. By using tolu water in place of plain water, a more stable preparation is said to result. As it contains about half an ounce of the gum to the fluidounce of finished mucilage, we must take that quantity of acacia for our prescription."

The Senior proceeded to weigh the gum arabic, and, putting it into a perfectly dry, shallow mortar, waited for further orders.

"We might be in doubt," continued the Proprietor, "whether four fluidrachms or four drachms by weight of oil are to be taken; but as the physician, with a carelessness so often noted in designating quantities, omitted to prefix 'fl.' before the quantities of Aqua Gaultheriæ and Mucilago Acaciæ, where fluidounces are evidently intended, we are justified also in taking four fluidrachms of castor oil. Now, in measuring the oil, let me give you a little, but valuable, hint. You know that it is almost impossible to pour all the castor oil out of a graduate, since, owing to its adhesiveness, a considerable part of it—in cold weather often as much as twenty-five per cent.—will cling to the glass unless we hold the graduate a very long time over the mortar. This can be avoided by simply heating the graduate before using it. In our laboratory, where we have running hot water, we can easily do this. I put a one-ounce graduate into a larger one, and let the hot water cover it for a while; then I pour the water off, dry the graduate quickly, and measure the oil, pouring it out again at once, and you see that hardly any of it remains in the graduate. The reason for this is that the outer layer of the oil, touching the hot graduate, became hot itself, and in consequence more fluid."

"Let me stir this," said the Junior, taking the pestle; "it is the first emulsion that I prepare."

"Aqua Gaultheriæ," continued the Proprietor, "is not an official preparation, nor would it keep, if prepared, like other medicated waters, from the oil, owing to a fungous growth in the 'methyl salicylate,'—the chemical name for absolute wintergreen oil. In the case before us we add two drops of the oil to the castor oil, and thus prepare the prescribed amount of wintergreen water at the same time with the emulsion."

The Junior, resting from his work a moment, said:

"Did you not tell us that a quantity of gum equal to one-fourth of the castor oil would make a good emulsion? Why, then, did you take half an ounce?"

"Simply because the physician ordered half an ounce. To misuse a general rule of pharmaceutical manipulation by letting it induce us to change a prescription would be an unpardonable misapplication of knowledge. Add now one fluidounce of water, which is also more than the general formula indicates; but, owing to the larger quantity of gum, a proportionately larger amount of water is required."

After a while, during which the Junior stirred the mixture violently, a very thick emulsion resulted; and by adding, first, the syrup of tolu, and then enough of water, under continuous stirring, the required quantity was soon obtained. Holding up the bottle, with snow-white contents, the Proprietor continued: "The prescription, as we prepared it, would read, rewritten in pharmaceutical parlance:

Ol. Ricini, f℥ss;
Ol. Gaultheriæ, gtt. ii;
Gum. Acaciæ, ℥ss;
Syrup. Tolut., f℥iv;
Aquæ, q. s. ad f℥iii.

"Remember, also, whenever you are called upon by a customer to prepare a palatable emulsion of castor oil, that this combination of wintergreen and tolu, which I suggested to the doctor some time ago, surpasses all others, although two or three drachms less of acacia than this prescription calls for would be sufficient."

"Why," exclaimed the Junior, tasting the prescription, "this is so pleasant that I would almost wish to need it myself. But no wonder; it is I who made it."

"The art of preparing nauseous medicines," said the Proprietor, "in a pleasant and palatable form, is comparatively new. Much study has been devoted to it of late. It is the tendency of our age to cover everything that is unpleasant in taste, and present to the senses only the beautiful and refined. This desire to hide whatever is offensive is not only noticeable in such small matters as prescriptions, but in almost everything around us, not seldom at the expense of truth and honesty. This latter should never be the case in our profession. To prepare an elegant, sweet elixir of iron and quinine by omitting the quinine, or to claim the virtues of cod-liver oil in an elegant preparation that contains none, is mere deception; and the unfortunate victim who sacrifices real medicinal worth to such outward elegance will in vain hope for recovery."

CHAPTER X.

WEIGHING TOLU—SYRUP OF TOLU—MEDICATED SYRUPS—SOURING OF SYRUPS—GLYCERITES—SOLUTIONS—MIXTURES—PREJUDICE IN MEDICINE.

"I BEG your pardon," said the Manager to the Proprietor, holding a round tin box in his hand; "I wish to make the concentrated tincture of tolu, and am at a loss how to weigh the necessary quantity of tolu without wasting any. The balsam in the box is almost solid, and very difficult to handle."

The Proprietor replied: "An easy method to weigh any quantity of balsam of tolu is the following: Take any convenient dish,—for instance, this small tin pail,—put hot water into it, and into the water the container with the balsam. If necessary, apply heat until the balsam is perfectly liquid. Now take some clean white paper,—a piece of wrapping-paper will do,—put it on a plate or pill-tile, and pour the liquefied tolu on it in a circle, so as to obtain a spiral band. Now expose the pill-tile, paper, and tolu for a few minutes to cold,—in winter the air outside is sufficient, in summer use the ice-box. The tolu hardens very quickly, and we can then weigh any convenient quantity by cutting the band with the scissors."

"And the paper adhering to it?" asked the Junior.

"In the further process of making the syrup, the tolu water, for which this concentrated tincture is made, must be filtered, and the paper will thereby be removed. Should the almost insignificant weight of the paper trouble your pharmaceutical conscience, you can allay it by putting pieces of paper of equal size on the counter-scales."

He poured out the tolu while explaining the process, and the Manager, after weighing the necessary quantity,—namely, fifty cubic centimetres to make five litres of syrup,—put it into a flask and added two hundred and fifty cubic centimetres of alcohol. He then held the flask over the flame of a Bunsen burner, removing it often to shake it and prevent the alcohol from reaching the boiling-point. In a few minutes the tolu was dissolved, while the small pieces of paper and other impurities floated in the tincture. He had previously mixed two hundred and fifty grammes of calcium phosphate with seven hundred and fifty grammes of sugar, and upon this mixture he now poured the tincture just prepared, constantly stirring, to insure thorough incorporation.

"This mixture," said the Proprietor, "must be set aside in a moderately warm place to let the alcohol evaporate. This radiator here is well adapted for the purpose in winter, whereas in summer the warm rays of the sun will do the work. Afterwards we will add water, filter, and dissolve the sugar in the filtered tolu water. While this is going on," he continued, turning to the Senior, "you might tell us why we dissolved the balsam of tolu in alcohol, if we knew that the latter would afterwards be evaporated again."

The Senior, radiant with joy to show his knowledge, replied: "Syrups are concentrated solutions of sugar in plain or medicated waters. Whenever the medication is of such a nature that water alone will not readily dissolve the active parts of the drug, we use a tincture or fluid extract; or, as in the case before us, we make one extemporaneously for the purpose, with the aid of alcohol. But the alcohol is objectionable in the syrup of tolu, and is therefore evaporated later on. By its aid the phosphate of calcium and sugar have been thoroughly impregnated with the tolu, which is by this process incorporated in the water."

"Is there any other syrup that is made like syrup of tolu?" asked the Proprietor.

"Yes, sir," replied the Senior: "syrup of ginger, in which the official fluid extract is used. By a similar process—namely, forming the medicated water first, and dissolving the sugar in it, either by the aid of heat or by agitation—are made Syrupus Aurantii, Syrupus Aurantii Florum, Syrupus Ipecacuanhæ, Syrupus Senegæ, Syrupus Scillæ Compositus, Syrupus Picis Liquidæ, and Syrupus Lactucarii. We might add to this list Syrupus Sarsaparillæ Compositus, in which the medicated menstruum is made by mixing a number of oils and fluid extracts with water, and filtering."

"And which are the syrups that are made by simply mixing the medicating liquids with simple syrup?"

The Senior answered: "Syrupus Rhei, Syrupus Rhei Aromaticus, Syrupus Acaciæ, Syrupus Acidi Citrici, Syrupus Krameriæ, Syrupus Rosæ, and Syrupus Rubi."

"What other processes are used in making syrups of vegetable drugs?"

"Syrupus Scillæ and Syrupus Alii require diluted acetic acid to macerate the drug; Syrupus Althææ, Sennæ, and Pruni Virginianæ are made from infusions; Syrupus Amygdalæ is prepared from an emulsion obtained by triturating blanched almonds with orange-flower water; and Syrupus Rubi Idæi by dissolving sugar in the expressed juice of the fruit."

"Does this list exhaust the number of official syrups?"

"No, sir; there are a number of medicated syrups containing inorganic substances, such as Hypophosphites, Hydrated Lime, Iron Iodide, Iron Phosphate, Hydriodic Acid, and Calcium Lactophosphate. Some of these are made by simply dissolving the chemicals in the syrups, while a few undergo a chemical change in the process of preparation."

"How is it that syrups will sour?" asked the Junior.

"In preparing simple syrup," replied the Proprietor, "great care should be exercised to use the proper amount of sugar. If too little is used, fermentation is apt to take place; if too much, some of the sugar will crystallize out, and the crystals afterwards attract more sugar, thereby rendering the syrup too thin, so that, in both cases—abundance or deficiency of sugar—the final result is the same. In some medicated syrups the proper proportion of sugar and water is destroyed in the official formula itself. Take, for instance, aromatic syrup of rhubarb. One hundred and fifty cubic centimetres of aromatic tincture are directed to be mixed with eight hundred and fifty cubic centimetres of simple syrup. If this latter be merely of the official strength, the mixture will contain too little sugar, and fermentation will thereby be invited. The recommendation to substitute glycerin for a part of the simple syrup, in such easily decomposed syrups, on account of its preserving properties, seems to be a good one."

"There are some preparations now," interrupted the Senior, "that are made of glycerin alone."

"You are right," said the Proprietor; "but the glycerites, as they are called, are no substitutes for syrups. Yet, as you mention them, we may as well review them. Three of them are solutions of organic acids in glycerin; do you know their names?"

"I do," replied the Senior. "They are Glyceritum Acidi Carbolici and Glyceritum Acidi Tannici, both containing ten per cent. of the acids, and, thirdly, Glyceritum Boroglycerini, containing thirty-one per cent. of boric acid. Another glycerite that is much used in making pills is the Glyceritum Amyli, containing ten per cent. of starch."

"Besides these, we have two others," continued the Proprietor,—"the glycerite of yolk of egg, Glyceritum Vitelli, being a mixture of forty-five parts of the yellow of eggs and fifty-five parts of glycerin; and the Glyceritum Hydrastis, being a mixture of equal parts of glycerin and a preparation of hydrastis, resembling a fluid extract. It was introduced in the 'Pharmacopœia' to replace similar proprietary articles, and put among the glycerites, although it hardly belongs there, if we define this term as a solution of some medicinal substance in glycerin."

"What advantage have these glycerites over other preparations?" asked the Junior.

"Glycerin possesses a number of properties that make it a desirable vehicle or solvent of medicinal substances. If used externally, as the glycerite of carbolic acid and boroglycerin, it will not, like ether, alcohol, or water, dry up, but remains permanently liquid. It therefore resembles the fixed oils, without sharing their tendency to become rancid. If used internally, its sweetish and not unpleasant taste, its great preservative influence, which not only protects against oxidation, but also against fermentation by its destructive agency on low animal life, render it very valuable. To these advantages must be added its great solvent power, sometimes surpassing that of alcohol and water. Its use in pharmacy and medicine is comparatively recent, but is extended with every new edition of our 'Pharmacopœia,' replacing gradually sugar and honey."

"But honey is still official," interposed the Senior.

"So it is,—namely, as clarified honey, Mel Despumatum; and honey of roses, Mel Rosæ. The former contains now, according to our 'Pharmacopœia,' five per cent. of glycerin, but in reality much more, and the latter is a mixture of fluid extract of rose with honey, formerly much used, but now in little demand."

"I often wondered," said the Senior, "at some of the prescriptions of one of our physicians, who orders a number of salts to be dissolved in a syrup which is already a saturated solution of sugar."

"This one, for instance," said the Proprietor, pointing to a three-ounce prescription that had been prepared before, and showing them the prescription, which read:

℞ Chloral, ʒii;
Ammon. Brom., ʒii;
Potass. Brom., ʒii;
Sod. Brom., ʒii;
Calci. Brom., ʒii.
Syr. Aurant. Cort, q. s. ad f℥iii.

"If you put all these salts into a mortar with the syrup and stir it, it will take a very long time to dissolve them; but by applying heat the solution is effected quickly, and no crystallization takes place on cooling. This prescription teaches us that a liquid may be saturated with one chemical and yet be able to dissolve others. There are even cases where the presence of one soluble body increases the solubility of another. For instance, a water holding ammonium chloride in solution will dissolve more corrosive sublimate than distilled water."

"Is there any definite rule or law about the solubility of bodies?" asked the Senior.

"No such law is known," replied the Proprietor. "We know that certain conditions, such as temperature, will exercise an influence on the solubility of bodies; we also have experimentally determined the solubility of almost every solid and gas in various liquids. But a natural law or formula, by which we can, beforehand, assert that such a solid must be soluble in such a liquid in a certain proportion, is not yet known. I do not doubt that there is such a law, for Nature is not guided by chance or fancy; nor do I doubt that this general law of solubility will some day be discovered. Our ignorance in this matter shows us how jealously and carefully Nature guards her secrets, and we must quietly wait either for her favorite son, who may, by frolicsome flattery, steal into her confidence, or the mental giant who, by superhuman thought, forces her into submission and makes her reveal her secrets."

After these words he went into the store, where a customer had asked for him.

"I have a prescription here," said the customer, "that I want you to prepare, provided you will do it in the right way. I have used this medicine against indigestion for a number of years, and when my physician gave me the prescription he said it would be a perfectly clear solution. Now, in some pharmacies they gave me an unsightly, turbid mixture, and claimed that the prescription calls for it; and of late I have also occasionally noticed a peculiar sweetish taste that was absent in the mixture as first prepared. Take a copy of the prescription. I wish to keep the original. Can you compound it so as to obtain a bright and clear preparation?"

The Proprietor looked at the prescription, and replied: "Certainly; it will be ready in a few minutes." And he proceeded at once to prepare it, without paying any attention to the doubtful looks of the Senior, who had read the prescription and seemed to be of a different opinion.

When the customer received the medicine he insisted on tasting it, to allay his suspicion, and then left, perfectly satisfied. There being no other business at hand, the Proprietor asked the Senior whether he thought there was anything wrong with the medicine.

"Well," said the Senior, "you certainly did not use the rhubarb and soda mixture of the new 'Pharmacopœia.'"

"Nor would it have been right if I had," said the Proprietor. "Let us look at the prescription again. Here it is:

℞ Ext. Ipecac fl., ♏x;
Mist. Rhei et Sod., f℥vi.

"You ought to know that the official formula for rhubarb and soda mixture underwent a considerable change in the last revision of our 'Pharmacopœia' by the addition of fluid extract of ipecac and glycerin. The first item was formerly often prescribed together with rhubarb and soda mixture, being therapeutically of great value as an adjuvant, and the glycerin has been added to make the preparation more stable, and imparts to it a sweetish taste. The customer told us that he has had the prescription a number of years, and for this reason the older official mixture should be used, of which I still keep some on hand. By taking the preparation which is now official, we would not only change the taste of the medicine, but also the prescribed dose of ipecac, because of the ipecac contained in the present official mixture of rhubarb and soda."

"But how about the clear solution?" asked the Senior.

"The revisers of our 'Pharmacopœia' evidently intended the slight deposits caused by the addition of fluid extract of rhubarb and spirit of peppermint to the aqueous menstruum to remain in the mixture and to be distributed through the supernatant clear liquid on dispensing. This intention is indicated by the calling the preparation a 'mistura,'—that is, a preparation in which insoluble substances are suspended by the intervention of gum arabic or other viscid matter. In those pharmacies, therefore, where our customer received a turbid medicine, these instructions were strictly followed. But the majority of physicians and pharmacists prefer a clear, filtered mixture, and as the deposit is inert anyway, there seems to be no objection to such a procedure. You know that I keep both kinds ready, as our physicians differ in this respect."

"By filtering Mistura Rhei et Sodæ it ceases to be a pharmaceutical mixture," the Senior remarked.

"You are quite right," replied the Proprietor; "it becomes one of those compounds that are hard to classify. This is true also of the best-known official mixture,—Mistura Glycyrrhizæ Composita,—which was formerly a muddy compound, owing to the copious deposit from the impure extract of liquorice used in its preparation. The 'Pharmacopœia' of 1890 substitutes for the latter the purified soluble extract, and simple syrup and mucilage of acacia for the sugar and gum arabic of the old formula, and, if properly made, the finished product is an almost perfectly clear solution."

"I dispensed some of it the other day, and it was brought back," said the Senior.

"So it was," answered the Proprietor. "The idea of a muddy mixture, to be shaken before taking, is so firmly associated with 'Brown Mixture' that it will take many years to convince the public—especially the ignorant element of it—that the clear mixture is the same as, and even an improvement on, the old one. The conscientious pharmacist has to choose between strict adherence to the requirements of the 'Pharmacopœia,' at the risk of losing a customer, and yielding to general prejudice that will occasionally cling to firmly rooted habits and opinions; for, as Schiller says,—

> "'Man clings tenaciously to old traditions,
> Obeying Custom, his beloved nurse.'

Where, as in our case, no danger is attached to giving the one for the other, the best way is to keep both preparations until, by constant reminding and explaining, the public gradually becomes educated to the use of the official article."

The Manager, who was all this time engaged in the laboratory, entered at this juncture, and, overhearing the last words of the conversation, said:

"Not only the ignorant cling to old prejudices, but also the learned and wise are guilty of such foolishness. Take, for instance, the word 'mistura.' The very word implies that the preparation should be a compound of miscible articles,—for instance, chloroform and soap liniment, or potassa solution and water,—but it is officially used to designate preparations composed of ingredients that will *not* mix, reminding us of the famous 'lucus a non lucendo.' I do not think that any of the revisers of the 'Pharmacopœia' thought of this anomaly, but felt convinced of the correctness of the venerable term, else they would have abolished it."

"Are there any other official mixtures besides Mistura Rhei et Sodæ and Mistura Glycyrrhizæ compositæ?" asked the Junior.

The Senior replied: "Yes, sir; there is the well-known chalk mixture, 'Misturæ Cretæ,' made by adding compound chalk powder to water and cinnamon water; also the compound iron mixture, 'Mistura Ferri Composita,' often called 'Griffith's Mixture,' after the physician who introduced it. It is a compound made by the action of potassium carbonate on ferrous sulphate, holding potassium sulphate in solution and ferrous carbonate and myrrh in suspension. It is flavored with spirit of lavender and rose water. Both these mixtures easily decompose, for which reason the 'Pharmacopœia' directs them to be freshly made when wanted."

CHAPTER XI.

LIQUOR FERRI CHLORIDI—PHARMACEUTICAL CHEMISTRY—TESTING—OFFICIAL LIQUORS—WEIGHT AND MEASURE OF LIQUIDS.

"WHAT is this?" asked the Proprietor, turning to the door of the laboratory, from which a peculiar odor emanated.

"Oh, I forgot to open the flue," said the Manager, quickly walking to the opposite side of the laboratory. Here, over a working-table, a conical chimney—commonly called a "hood"—was arranged and connected with the main chimney of the house. It served to collect and carry off such vapors or gases as would, if dispersed through the building, contaminate the atmosphere. Under the hood there was a small gas-stove, with a flame covered with a fine wire-netting, and on this net a flask of the capacity of about two quarts, and containing a somewhat dirty, greenish liquid, just beginning to boil.

"This is going to be 'Liquor Ferri Chloridi,'—solution of ferric chloride," said the Manager, turning off the gas. "I put the iron and the proper mixture of hydrochloric acid and water into the flask, and after effervescence—that is, the evolution of hydrogen, freed by the action of the iron on the hydrochloric acid—had ceased I proceeded to boil the solution, placing the whole apparatus under the hood, but forgetting to open the damper."

Noticing that his younger associates were waiting for further information, he continued: "This green liquid is a solution of ferrous chloride, and would, on standing, deposit green crystals. The next step is to filter it," he continued, pouring the liquid on a funnel with a folded filter that he had previously prepared.

"I know very little about chemistry as yet," said the Junior; "but I must say that of all the different branches of pharmacy, pharmaceutical chemistry, or chemical pharmacy,—whatever you may choose to call it,—has the greatest attractions for me."

"And it is really the most interesting and wonderful science extant," said the Proprietor, "and we pharmacists ought to cherish and cultivate it as much as we can.

"Do you know that pharmacy is the mother of chemistry, and that some of the greatest discoveries of chemistry have been made by studious pharmacists in the quiet of their often very primitive laboratories, prominent among whom was the Swedish apothecary, Scheele? Thus has chemistry been reared and raised by pharmaceutical nurses; and it speaks well for those early educators that the infant has grown and developed wonderfully and to-day stands before us in the full strength of manhood. But, like a dutiful child, it does not forget, in its days of prosperity, its modest mother; and so we see chemistry supply medicine and pharmacy to-day with new and wonderful remedies, like a tribute paid by a rich, successful son in acknowledgment of the former benefits received from his humble parent.

"And, indeed, chemistry is worthy of the attention of the greatest minds. Is there anything more wonfully simple, and yet mysterious, than the development of a chemical process? Take, for instance, the formation of a crystal. You see before you a clear liquid. There is no sign of life, no motion, no action. Your look is intensely bent on the fluid; your mind bids you watch the hidden creative power, to lift the veil from nature's secret working. Suddenly you ask, 'What is that?' A fine needle lies at the bottom of the porcelain vessel. Where did it come from? Who put it there? What mysterious power called it into existence? A thought of disappointment, of anger, flashes through your mind. Is not this your liquid? Did you not prepare it? Why, then, was it changed without your consent? Who dared alter its nature? Alas! that small, insignificant crystal suddenly taught you the limit of human knowledge, showed you the narrow circle of your mind, and forced from you the acknowledgment of submission to a higher, unfathomable power. The unsolved problem of creation lies before you; the created object is there; the creator, whatever you may call him, far above your sphere, your comprehension. And before you recover from your surprise and disappointment, there is another crystal, and a third one, too. From all directions they spring, like the many varied thoughts of an active mind, seemingly in confusion, and yet following a strict and distinct law, and forming beautiful and harmonious combinations. Your disappointment now gives way to admiration; you bow before the wonderful powers and mysterious actions of Nature."

"And yet," said the Manager, "there are but few that have such a bright and interesting conception of their profession, and who will engage in even the simplest chemical operation. In my long experience in the various positions that I have had, both as clerk and as manager, you are the first employer who prepares his own Liquor Ferri Chloridi."

"I well know that this state of affairs does exist," said the Proprietor, "and I am very sorry for it. Aside from losing a good deal of money, those pharmacists forego some of the greatest pleasures that a professional occupation can afford. They are like men who own a fiery horse, but who, either through laziness or ignorance, will not mount it themselves, but rather force it into a clumsy harness, let a coachman drive it, and, leaning back into the cushion of the carriage, exclaim in ecstasy, 'How beautiful it is to own a horse!' That is not my way. My steed and I are friends. He knows the touch of my hand, the motion of the bridle; racing over hill and vale, he feels with me the joy of seeing Nature all around and discovering new beauties at every step; and while I let him trot and gallop in prancing buoyancy, I keep a ruling hand on him and guide his course. Thus I like to roam through the realm of chemistry and science,—no hurdle too high, no ditch too wide, no hinderance too difficult to overcome,—feeling and choosing my own way; and what I observe and discover is my own."

During this conversation filtration had progressed, and the solution of ferrous chloride was before them,—a clear, green liquid.

"We now add more hydrochloric acid," said the Manager, "and then pour the mixture into a certain quantity of nitric acid, which will at once form a solution of red ferric chloride out of the green ferrous chloride. Formerly the nitric acid was added to the solution of ferrous chloride, when a sudden evolution of nitrogen dioxide would take place with such violence that for quite a while the whole laboratory would be filled with the noxious gas, in spite of all precautions. It took many years to discover that by reversing the order of pouring the liquids together the sudden generation of N_2O_2 could be avoided. Professor C. L. Diehl, of Louisville, I believe, deserves the credit of the innovation."

"Is the solution now finished?" asked the Junior.

"No," said the Manager; "we must heat it again carefully on a sand-bath, to drive off all the nitrogen dioxide, and after that two tests are necessary. First, we put a clear crystal of ferrous sulphate into a mixture of sulphuric acid and a diluted portion of the solution. If a brown color is shown around the crystal, nitric acid is still present, and it is then necessary to heat the solution once more. Secondly, we test a few drops of the liquor with a freshly prepared test solution of potassium ferricyanide. A blue color indicates the presence of ferrous salt, and it will then be necessary to carefully add a few drops of nitric acid. Finally, we add some drops of nitric acid, of which the finished preparation must contain an excess."

"Taking all in all," said the Junior, "this is rather a complicated preparation. Are all the official liquors so difficult to prepare?"

"By no means," answered the Proprietor. "Some of them are prepared by simply dissolving a chemical compound in water,—for instance, Liquor Potassæ or Liquor Calcis. There is no general formula for their preparation. Each must be prepared according to the characteristics of its ingredients, and more or less care is necessary with all of them."

"Do they all contain metals?" the Junior asked.

"With the exception of Liquor Ammonii Acetatis, they do. They are aqueous solutions of non-volatile substances, containing neither sugar nor oil, and form a bridge between pharmacy and chemistry. Let us see if we can name them. Ammonium furnishes one, —Liquor Ammonii Acetatis, arsenic two,—Liquor Acidi Arseniosi and Liquor Arseni et Hydrargyri

Iodidi; calcium one,—Liquor Calcis (lime water), one of the best known preparations; iron, seven solutions, taking the lead among the metals."

"Let me see if I know them all," interrupted the Senior. "Liquores Ferri Acetatis, Ferri Chloridi, Ferri Citratis, Ferri et Ammonii Acetatis, Ferri Nitratis, Ferri Subsulphatis, and Ferri Tersulphatis (useful in preparing a prompt antidote in cases of arsenical poisoning)."

"Correct," said the Proprietor. "The next metal, iodine, furnishes one solution,—Liquor Iodi Compositus; and mercury also one,—namely, Liquor Hydrargyri Nitratis. The Liquor Magnesii Citratis is well known to you as the only representative of magnesium. Lead gives us two,—Liquor Plumbi Subacetatis and Liquor Plumbi Subacetatis Dilutus; while potassium furnishes us with three,—Liquores Potassæ, Potassii Arsenitis, and Potassii Citratis. Sodium takes the place after iron, with four official solutions, —namely, Liquores Sodæ and Sodæ Chloratæ, Sodii Arsenitis, and Sodii Silicatis; and zinc ends the list with one solution,—Liquor Zinci Chloridi."

The Manager had meanwhile finished the iron solution, and, holding up the one-quart stock-bottle, showed it to the other pharmacists.

"Why did you not fill the bottle?" asked the Proprietor.

"By an oversight," replied the Manager, "I started to prepare the solution according to the new 'Pharmacopœia,' thinking that the formula called for one thousand cubic centimetres, as most formulas do. But in this case it calls for one thousand grammes, and as the specific gravity of the solution is 1.387, the thousand grammes by weight correspond to about seven hundred and twenty-one cubic centimetres by measure. The next time I will be wiser and make one-third more."

"This is a puzzling thing to me," said the Junior, "this conversion of common weight and measure into metric weight and measure, and *vice versa*. It always takes me a couple of minutes to find my way through the confusion that arises every time in my mind when I hear about so many 'cubic centimetres' or 'grammes.' I would be thankful if you would explain to me the intricacies of this perplexing subject."

"The reason of the perplexity of the metric or decimal system," replied the Proprietor, "is given in your question. As long as you try, in every instance, to convert one measure into another, you will vainly look for a solution of the problem. The metric system was introduced to facilitate weighing and measuring, and as a succedaneum for other comparatively cumbersome methods. The intention was not that it should be transposed into them."

"But how can I understand what so many 'cubic centimetres' are," replied the Junior, "unless I convert them into fluidrachms and fluidounces?"

"Tell me, first, why do you understand what so many fluidrachms are?" asked the Proprietor.

"Well, because I know exactly what one fluidrachm is," came the answer. "I see before me the drachm graduate, with the delicate cross-lines and the figure one, and that tells me what a fluidrachm is."

"Exactly," said the Proprietor; "and if you will learn to see in your mind a graduate, with a small line marked 'one cubic centimetre,' or 'five cubic centimetres,' you will at once know what so many cubic centimetres are; and after you have once impressed on your mind such a plastic representative of the cubic centimetre, the comparison of the two impressions—that is, of the two systems—is a very easy matter."

"Well, I never thought of that," replied the Junior.

CHAPTER XII.

THE METRIC SYSTEM—THE METRE—THE STERE—THE GRAMME—THE KILOGRAMME.

"BEFORE I explain the metric system to you," the Proprietor continued, "let me tell you of a difficulty similar to the perplexity under which you labor. Some time ago I had a clerk, just immigrated from Germany, who had the greatest trouble in getting used to our money. Whenever he bought or sold an article he figured out the price in 'marks,' the German standard, and, although he seldom made a mistake in figuring, he could not acquire a correct idea of the value of things. The reason was this: The silver value in our money of a 'mark' is about twenty-three cents; but the purchasing power of money being different in Germany from what it is here, the association of ideas in his mind concerning the 'mark' could not be applied to the twenty-three cents without causing confusion, and he never knew whether an article was expensive or cheap. In the same way there are certain traditions associated with the fluid-drachm and the fluidounce to which the metric system—a perfect entity in itself—cannot be forced to adapt itself. As soon as you learn to consider it by itself, on its own merits, you will be surprised at its simplicity, and feel ashamed that it took you so long to understand it."

"We are always told that this new system is simpler," said the Junior, with the obstinacy of the half-informed, who tries to defend an untenable argument against his own better judgment, "but I cannot understand why a subdivision into ten should be simpler than one into twelve, like the linear foot, for instance. How much easier it is to take fractions of it, like fourths, thirds, sixths!"

"In the countries where the decimal system is introduced, people soon cease to ask for thirds and sixths; they ask for so many tenths, and the arithmetic becomes easier. And do not forget that the universal method of counting is a decimal system, and we can hardly realize the advantage derived from the fact that every country of the earth uses it. What a confusion it would cause if England, for instance, would adopt a method of counting by twelves, on the plea of greater simplicity on account of its divisibility; inventing a new symbol for ten and eleven, and commencing the next higher order with twelve, and so on! Whatever we think or talk or write about figures is so thoroughly connected with and based on the decimal system that the very idea of such a deviation from the universal rule appears ridiculous. If, then, in all our counting and figuring the decimal system is good, why not also in weighing and measuring? Has it ever been considered a hinderance to trade or commerce that the hundred cents which make one dollar are not evenly divisible by three or six or eight? Take any figure,—for instance, 12,345. Every child can at once answer the question, how many units there are in it, or how many tens or hundreds, and so on. But now ask how many gallons, pints, and ounces are in 12,345 fluidrachms, and it becomes necessary to do quite a little figuring to find the correct answer. You see, divisibility is nothing but a paper target for the piercing arrows of logical argument in favor of the metric system."

"I understand," said the Junior, desperately looking for another straw of objection, "that a 'metre' is three feet three and three-eighths inches. Why did they not make it exactly one yard?"

"Fortunately, they did not," replied the Proprietor, "or the temptation might exist for each nation to substitute the word 'metre' for their respective 'yard,' and we would possibly have as many 'metres' as we have 'yards.' The confusion would be the same. The metric system was intended to be something new and capable of universal application; it has nothing in common with the former system of any nation."

"How, then, was the length of the metre determined?" asked the Junior.

"The circumference of the earth, measured through the poles, was divided into forty million parts, and each such part was denominated a metre. This measure—'metre'—is derived from the Greek 'metron,' meaning a measure, and has, therefore, no connection with any pre-existing system.

"The metre is the unit of length," the Proprietor continued. "It has been divided into ten parts, each of these again into ten, and so on, each subdivision receiving a separate name, obtained by putting the corresponding Latin prefix before the word metre. 'Decimetre' means one-tenth of a metre; 'centimetre,' one-hundredth of a metre; and 'millimetre,' one-thousandth of a metre. In figuring, these subdivisions are written, like decimals, to the right of the period, while the number of whole metres is placed to the left. Thus, M. 4.127 means four metres, one decimetre, two centimetres, and seven millimetres. Often the intermediate divisions are not named; M. 4.127 may also read four metres and one hundred and twenty-seven millimetres. In a similar way, higher denominations are formed from the metre by using prefixes derived from the Greek names of ten, hundred, and thousand,—deca, hecto, and kilo; so that decametre means ten metres; hectometre, one hundred metres; and kilometre, one thousand metres. Thus, M. 3521.306 can be read three thousand five hundred and twenty-one metres and three hundred and six millimetres; or three kilometres, five hectometres, two decametres, one metre, three decimetres, no centimetres, and six millimetres. Suppose there were 3521.306 inches; could you with the same ease read off the numbers of rods, yards, feet, and inches contained in them?"

"I guess not," said the Junior. "It is, as I understand it, not necessary to write the names of the different sub-denominations; the position of the figure will tell what it is."

"You are right," said the Proprietor, "and that is another advantage over the old system."

"But how do we get at the weights?" asked the Junior.

The Proprietor, holding in his hand a rod the length of one metre, continued: "This metre is used to measure distances, and all such articles as we generally sell by linear measure,—cloth, thread, twine, etc. If we now lay out a square bounded by four metres, just as I draw it here on the floor, we obtain a square metre. This is used for measuring surfaces, such as lots for buildings, gardens, etc. If we go a step further we have a cube bounded by six square metres, forming a cubic metre, a measure of capacity. The last step in the series is to fill this cubic metre with water at its greatest density (4° C.), and this amount of fluid gives us a measure of weight. In these successive steps the whole principle of the metric system is contained."

After these words there was a lengthy pause. The Junior seemed to reflect and try to fully understand the meaning of what he had been told. He looked at the square metre on the floor, and held the stick, which the Proprietor had left there, in one corner of the square in a perpendicular position, in order to help his imagination in the formation of a cubic metre. Then he cast a glance at the small graduates on the table, and compared them with the immense measure of capacity depicted before him. The thoughts that went through his mind did not seem to satisfy him, for he shook his head doubtfully and said:

"I can understand that this square metre is useful to measure surfaces; but this cube, larger than the largest packing-box, would be a very awkward measure for such small quantities as pints or ounces; and, finally, if we come to weights, why, the weight of such a mass of water must be immense! And how can we use it to weigh a grain, or even a drachm?"

"I am pleased to hear you make these objections," said the Proprietor, "for it shows that you understand what I tried to explain, and are ready for further information. Such a cubic metre, for which the term 'stere' is used in Europe, would indeed be an awkward measure, except for measuring very large spaces, such as excavations for buildings or streets. For ordinary use it would need a great many subdivisions to reduce it to a convenient size, or, rather, smallness. Theoretically there can be no objection to such numerous subdivisions, but the figures and fractions with which we would have to operate would be very large and inconvenient. Besides, the human mind can, after some practice, comprehend the value and importance of the figures up to one thousand, but beyond that the conception becomes uncertain and confused to the majority of men. All these considerations naturally pointed to the necessity of a smaller unit of capacity than the stere, and the question arose how to get it without destroying the order and harmony of the system."

The Junior, who had carefully followed the discourse, happened to spy at this moment a quart graduate, and said, "If we could get a cube holding about as much as a quart, I should think it might go."

"Let us then reflect as to what we can do. In the case of the cubic metre we started out by taking the metre; could we not try to take a shorter measure for the formation of a smaller cube? And, if so, what kind?"

"We might take half a metre, or a third," suggested the Junior.

"By doing so we would destroy the decimal arrangement of the system; for the cube of one-half is one-eighth, and the cube of one third is one-twenty-seventh."

"Oh, I see!" joyfully exclaimed the Junior; "we must start with one-tenth of the metre,—the decimetre."

"That's it," replied the Proprietor, drawing from his vest pocket a small folded rule of the size of a decimetre, and drawing a square with it on a piece of paper. "Let us proceed as before. We first draw a square decimetre, and then build a cube upon it. I have one here made of wood." He opened a drawer and took from it a cube-shaped cigar-box, such as is used for fifty cigars, and put it upon the square decimetre, covering it exactly.

"Aha!" cried the Junior; "that's more like it. The contents of such a cube can be more easily grasped."

The Proprietor said: "This cube represents what is called a 'litre,' the metric unit of capacity."

"So this is a litre," said the Junior. "I always thought of a wine-bottle when the word litre was mentioned."

The Proprietor replied: "In countries where the metric system is in vogue all measures of capacity—such as bottles, boxes, etc.—are made to conform with the unit,—the litre,—just as we have pint and quart bottles. The same Latin and Greek prefixes used in connection with the metre are joined to the word litre; 'decilitre,' therefore, means what?"

"One-tenth of a litre," quickly responded the Junior; "'centilitre,' one-hundredth, and 'millilitre,' one-thousandth of a litre. In the same way 'decalitre' means ten litres; hectolitre, a hundred litres; and kilolitre, a thousand litres. But how about weights?"

"Let us go slowly, so as to be able to understand everything thoroughly," said the Proprietor. "I will ask you one or two questions more. You have learned that the stere is the cube of the metre and the litre the cube of the decimetre; now tell me how many litres make a stere?"

"Well, ten," answered the Junior. But, looking at the small wooden box on the table and then at the large square on the floor, he at once discovered that his answer could not be right, and continued: "No, not ten, but one hundred—— Well, I don't know."

"Let me help you," said the Proprietor, taking the small cube and putting it on the floor in one corner of the square. He then took the metre-rod and held it in a perpendicular position at one corner of the litre and looked inquiringly at the Junior.

"Oh, I see!" exclaimed the latter; "it takes a row of ten such cubes to be put along one side of the square, and ten such rows to cover the whole square; that makes ten times ten, or one hundred."

"And how many such layers of one hundred litres do we need to reach to the top of this rod?" asked the Proprietor.

"Why, ten layers; so there are ten times one hundred, or one thousand, litres in one stere."

"Certainly. If the side of one cube is ten times as long as the side of another, the larger cube has ten times ten times ten, or one thousand, times the capacity of the smaller one. This is a simple example of arithmetic, and yet the cause of a great deal of the confusion that exists in respect to the metric system. Now, tell me by what term we would call the stere, or cubic metre, taking the litre as the unit?"

"Kilolitre, of course,—one thousand litres," said the Junior.

"Correct; and if we wished to name the litre by a term derived from the stere?"

"Millistere, meaning one-thousandth of a stere."

"Yes, sir," replied the Proprietor. "We will now proceed to the weights. As I said before, these are obtained by filling a cube with water at its greatest density, at about 39° F. or 4° C."

"A stere full of water," said the Junior, "would be an enormous weight."

"So it would," said the Proprietor, "fit only to weigh very heavy articles, like coal or iron. The name 'metric ton' is sometimes applied to it. But for every-day use—to weigh the articles bought at the grocer's or butcher's—a great many subdivisions would be necessary, not to speak of the smaller weights used in pharmacy; and we have here the same arguments in favor of a smaller unit that we considered when we constructed the litre."

"Then we also take the decimetre as the starting-point?" questioned the Junior.

"Still smaller," said the Proprietor.

"Well, then, it must be the cube of the centimetre," suggested the young man.

"That it is, indeed," replied the Proprietor. "A cube formed of the centimetre is filled with water, and the weight of this quantity of water, designated a 'gramme,' is the unit of weight. Here I have a 'one-gramme weight.'"

He showed the Junior a small cube, about the size of an ordinary die, each side of which measured one-hundredth of a metre in length.

"Tell me, now, how many of these cubic centimetres make a litre?"

The Junior was more careful this time in answering, and reflected quite a while before he spoke.

"The side of this cubic centimetre," he said, "is one-tenth that of the litre, or cubic decimetre. Its capacity is, therefore, one-thousandth that of the litre; or, in other words, one thousand cubic centimetres make one litre. Is that right?"

"It is," said the Proprietor.

"Then a cubic centimetre is the same as a millilitre?"

"Certainly; and I often regret that the term 'millilitre' is not used more frequently in measuring liquids. I think it would greatly help the student in comprehending the relation of metre, litre, and gramme. But in reality the term 'millilitre' is hardly ever used, the cubic centimetre (written c.c) having entirely superseded it."

The Junior was still examining the small cube, and said, finally: "The weight of this quantity of water must be very small, I should think, for every-day weighing."

"Do not forget," said the Proprietor, "that we can quickly make larger weights by multiplying with ten, with a hundred, and with a thousand."

"Oh, I see!" said the Junior; "we thereby get the decagramme, hectogramme, and kilogramme."

"Quite right. The first two terms are seldom used, but the kilogramme—commonly called 'kilo' for short—is the standard of weight in common trade, just as the pound is now. Here is a gramme weight and here a kilogramme weight," he continued, opening a small box that contained a full set of metric weights.

The Junior examined the different weights, taking up one after the other, when the Proprietor remarked:

"In this little cavity, covered by a brass cover, you find the smaller weights, which are of special interest to us pharmacists,—the decigramme, centigramme, and milligramme. But, as in former cases, only the term milligramme is generally used, and you, therefore, see on these small weights the marks 500, 200, 100, 50, and so on, meaning so many milligrammes. You, no doubt, now see that this decimal system is quickly adapted to the greatest length and smallest distance, and to the largest area and space, as well as to the minutest measure of capacity; to the heaviest weight, like the ton, and to the tiniest, for chemical and scientific purposes."

"It is, indeed, much simpler than I thought," said the Junior.

"And yet you have only learned the smallest part of its simplicity. How much more will you admire it when you come to its practical application."

CHAPTER XIII.

SYMBOLS IN THE METRIC SYSTEM—METRIC PRESCRIPTION—MISTAKES IN WRITING PRESCRIPTIONS—CONVERSION OF WEIGHT INTO MEASURE.

"WHAT abbreviations are used," asked the Junior, "in writing the different terms used in the metric system?"

The Proprietor replied: "M. stands for metre, L. for litre, and Gm. for gramme. The abbreviations of all the other denominations are formed by abbreviating the respective prefixes, using small letters for the lower and capital letters for the higher orders. For instance, Cm. means centimetre; Mm., millimetre; Hm., hectometre; Hl., hectolitre; Mg., milligramme; Kg., kilogramme; and so on. For cubic centimetre the abbreviation Cc., dropping the m, is generally adopted. In pharmacy only two signs are actually used,—Gm. and Cc. As I explained before, the position of the figure to the right or left of the decimal point will sufficiently indicate its meaning. Let us look at a few prescriptions to illustrate this still further."

He looked through the prescription-file, and soon found what he was looking for.

"Here is a very simple one," he said, pointing to the following:

Aristol	1.
Bismuth Subnitr.	4.
Amyli	15.

M. et ft. pulvis.

The Junior read: "Aristol, 1 gramme; Bismuth Subnitrate, 4 grammes; Starch, 15 grammes. I suppose the doctor means grammes, although he does not say so."

"What could he possibly mean besides gramme?" asked the Proprietor.

"Well, that is so; there can be no other meaning," said the Junior, "as long as the period is there."

"Now, read this one," said the Proprietor, pointing to the following:

Pepsin pur.	4.
Bismuth Subgall.	8.
Morph. Sulph.	.1

M. et ft. pulveres No. xii.

The Junior read: "4 grammes of Pepsin, 8 grammes of Bismuth Subgallate, and 1 decigramme of Morphine Sulphate."

"Correct," said the Proprietor; "and now find the decigramme among the weights."

The Junior took the set of weights and looked through them carefully. After a while he put them down again, rather discouraged, and said: "I thought I knew it all now, but I fail to find that weight."

"I told you before," said the Proprietor, "that the intermediate denominations between gramme and milligramme are little used, and in preparing and stamping the weights they are ignored entirely. These small weights, therefore, in the shape of flat pieces of metal are milligrammes, and in looking for a decigramme you have to convert it into milligrammes."

"That would be one hundred," said the Junior; "then the weight marked one hundred is the one to take. But," he added, "does not this give rise to confusion?"

"To avoid confusion and mistakes you should only use the term milligramme; and in reading the prescription always add to the figures so many zeros as to convert decigrammes and centigrammes to milligrammes. In our case add two zeros, and read one hundred milligrammes, instead of one decigramme, and no confusion can arise."

He then asked the Junior to read this prescription:

Strych. Sulph.	.03
Ac. Arsenosi	.05
Quin. Sulph.	4.
Podophyllini	.2
Pulv. Capsici	1.

M. et ft. pil. No. xxx.

"That is a puzzler," said the Junior.

The Proprietor replied: "Do as I told you, and supply the wanting zeros; and, if necessary for your better understanding, copy it with them."

The Junior followed his advice, and wrote:

Strych. Sulph.	.030
Ac. Arsenosi	.050
Quin. Sulph.	4.000
Podophyllini	.200
Pulv. Capsici	1.000

Then he read: "Strychnine Sulphate, 30 milligrammes; Arsenous Acid, 50 milligrammes; Quinine Sulphate, 4 grammes; Powdered Podophyllin, 200 milligrammes; Capsicum, 1 gramme."

"You see now," said the Proprietor, "that you can make no mistake if you will only remember that there must always be THREE decimals to the right of the period, and if there are less, a number of zeros must be added. It is the neglect of this rule that gives rise to mistakes by using a wrong denomination."

After some meditation the Junior said: "The only thing to look out for, then, is the period; if that is there, no further signs or letters are needed. But how easily might a doctor omit it!"

The Proprietor replied: "There is no safeguard against carelessness. He might just as well make an ounce sign for a drachm sign, or *vice versa.* Such mistakes, whether they are only slips of the pen or the result of negligence or over-confidence, should be detected by the pharmacist, whose duty it is to correct them; or whenever there is any doubt as to the intention of the prescriber, consult him before compounding the prescription. A physician once accustomed to the metric system will no more forget the period than another will omit the drachm or ounce sign.

"Some prescribers," he continued, "in order to avoid all possibility of mistakes, have a perpendicular line printed on their prescription blanks, which divides the grammes, or cubic centimetres, from the milligrammes, and takes the place of the period, as in this prescription:

	Gm.	Mg.
Quin. Sulph.	2	
Ferri Sulph. Exsic.	1	
Aloini		250
Leptandrini		500

M. et ft. Caps. No. xx.

But the careless prescriber might just as well put a figure at the wrong side of the line."

"I suppose that the so-called 'quacks' are the ones who are apt to make mistakes?" remarked the Junior.

"Not at all," said the Proprietor; "the physicians of limited learning and the 'quacks' are, as a rule, exceedingly careful. Conscious of their ignorance, and always afraid of being exposed, they seldom order potent drugs; and when they do, in very small doses, so that the error is generally on the side of safety. The men who make mistakes in prescribing are of two classes. The first class is composed of extremely conscientious doctors, who worry continuously over their patients, and, being busy from morning till night, and worn out by overwork, are apt to make slips. When their attention is called to the mistake, they are sincerely thankful, and return, whenever occasion offers itself, the service that the pharmacist rendered them. The other class consists of men who, having become prominent in their profession for some reason or other (often through some marked trait of character rather than great learning or skill), believe that they are stripped of all human frailty, and, far from admitting a mistake, treat the pharmacist who dares call their attention to it with contempt and scorn. I have in my possession a prescription written by one of the most renowned physicians of New York, in which is ordered one grain of strychnine at one dose, to be repeated every three hours. His intention probably was to order one grain for the thirty-two doses of the prescription, and I corrected the latter accordingly."

"Did you not tell the physician of it?"

"No, I did not. I remembered what a friend of mine told me about his experience with this same physician. He had a similar case, and went straightway to the prescriber, asking him, in a friendly way, to write another prescription. Instead of doing so, the doctor tore the faulty prescription into small pieces, and dismissed the pharmacist with the remark that he would see about it. A few days later the pharmacist met the patient, and, remembering that he had received no further prescription from him, asked him about it.

Reluctantly his customer told him that the doctor had advised him to go to another druggist, who understood his prescriptions better. So you see——"

Here the Proprietor was interrupted by the Senior, who came with an empty quart bottle, and asked if there was any more diluted acetic acid in stock.

"There is not," replied the Proprietor; "we only prepare this quantity at a time." And, turning to the Junior, he continued: "Here we have a good occasion to compare the working formula of the old system with that of the new. In most stores the acetic acid, containing thirty-six per cent. by weight of the glacial acid, is kept in stock, and the diluted acid, containing only six per cent., is made therefrom whenever wanted. Now, how shall we proceed to make it?"

The Junior said, after reflecting a short while: "If the one contains six per cent. of the glacial acid and the other thirty-six, all we have to do is to take one-sixth of the acid and five-sixths of water."

"But what do you mean by one- and five-sixths?"

"One-sixth by WEIGHT, of course."

"That is right. But suppose that we do not wish to make a certain quantity by weight, but by measure, as in our case,—one quart?"

The Junior did not seem at once to understand that this should make any difference, and looked inquiringly at his preceptor.

"How much will a quart of diluted acetic acid weigh?" asked the Proprietor.

"Oh, that is where the difference comes in!" exclaimed the Junior. "I don't know."

"How much will a quart of distilled water weigh?" then asked the Proprietor.

"Two pounds, of course," was the quick reply.

"No, it will not. Here is a difficulty which so many beginners in pharmacy and chemistry encounter. One minim of distilled water does not weigh one grain at ordinary temperature, but only 0.9508 grain. If you should ever forget this figure, you will find it at the end of the 'United States Pharmacopœia,' where a number of comparative tables are printed. Now, how many minims are there in one quart?"

The Junior took paper and pencil, and the Proprietor also figured the same examples, to control the correctness.

"Thirty-two times 480, or 15,360 minims," said the Junior.

"Now multiply this by 0.9508, the weight of one minim."

The Junior soon found the answer: "14,604.288 grains are the weight of one quart of water."

The Proprietor continued: "Diluted acetic acid is heavier than water, its specific gravity being 1.008. How much, therefore, will a quart of it weigh?"

The Junior replied: "The weight of water multiplied by 1.008,—that is, 14,604.288 times 1.008 grains." And, after figuring a while, he continued: "14,721.122 grains."

"And how much of this must be the stronger acid?"

"One-sixth, or 2453.520 grains; while the required quantity of water will be five-sixths, or 12,267.602 grains."

"These are the quantities of acid and water by weight necessary to make one quart of diluted acetic acid. But suppose that we should prefer to measure the ingredients, as, indeed, most pharmacists do in making their preparations, or that we had no accommodations for weighing, how would you proceed?"

The Junior meditated a few minutes, and then said: "One minim of water weighs 0.951 grain. We, therefore, have as many minims as 0.951 is contained in 12,267.602, which is 12,900, or, reduced to ounces by dividing by 480, twenty-six fluidounces and four hundred and twenty minims."

"That's right," said the Proprietor. "And how about the acetic acid, its specific gravity being 1.048?"

"We must, for the same reason, divide the number of grains—namely, 2453.520—by 1.048, its specific gravity. Thus we get as an answer 2341.145."

"Are these minims or grains?"

"Minims, of course."

"Think again," replied the Proprietor. "We had a given weighed quantity of acid, and divided it by 1.048, the specific gravity of the acid, which means a quantity of acid equal to such a quantity of water as would weigh one."

"Oh, I understand," said the Junior; "the answer is the number of grains that a corresponding quantity of water would weigh."

"That is so; and to change this weight of water to a measure, we must do what?"

"Divide by 0.951, just as we did before. 2341.145 divided by 0.951 gives two thousand four hundred and sixty-one minims of acetic acid, or, converting the minims to fluidounces, we have five fluidounces and sixty-one minims."

"The complete answer, therefore, is: To make one quart of diluted acetic acid, take five fluidounces and sixty-one minims of acetic acid (thirty-six per cent.) and twenty-six ounces and four hundred and twenty minims of water; by adding the two quantities you will notice an incorrectness of one minim."

"Well," said the Junior, "that is owing to the dropping of the lower decimals."

"Yes, sir; and also to the fact that the weight of water in our calculations relates to water of 4° C., while the specific gravity of the acids was based on a temperature of 15° C. But for all practical purposes our answer is near enough."

"What an amount of figuring we had to do!" said the Junior, looking over the two large pages of figures before him.

"Now let us do the same work, employing the metric system," said the Proprietor. "We will make one litre, or one thousand cubic centimetres, and go through the same process of reasoning. How much will such a quantity of diluted acetic acid weigh, its specific gravity being 1.008?"

"Why, one thousand times 1.008, or one thousand and eight grammes."

"And how much of this must be acetic acid?"

"One-sixth, or one hundred and sixty-eight grammes, and the balance, or eight hundred and forty grammes, is the weight of water."

"Suppose, again, we wished to measure instead of weighing, how much would the eight hundred and forty grammes of water measure?"

The Junior hesitated a minute, and then, struck with the simplicity of the system, exclaimed, radiantly: "They will, of course, measure eight hundred and forty cubic centimetres; for the weight of one cubic centimetre of water is what we call a gramme."

"Certainly; and how much is left for the acid?"

"One thousand, less eight hundred and forty, or one hundred and sixty cubic centimetres."

"We must, therefore, take one hundred and sixty cubic centimetres of acetic acid and eight hundred and forty cubic centimetres of water to make one litre of diluted acetic acid.

"If we wish to prove the correctness of our figures, we divide 168—that is, the weight of the acid—by its specific gravity, 1.048, and the answer must be 160, as, indeed, it is, barring a small fraction, for reasons explained before. Here we arrived at the same result in two minutes without even using pencil or paper!"

CHAPTER XIV.

SICK-ROOM APPLIANCES — UNPAID BILLS — QUEER CUSTOMERS—MEDICATED SPIRITS—TEST-ODORS—AROMATIC SPIRITS OF AMMONIA—OFFICIAL WINES.

WHILE the Proprietor was explaining to the Junior the metric system and its advantages, the other two clerks had an interesting experience in the store. A lady in mourning had entered, accompanied by a child, carrying a large bundle that she unpacked on the counter. It contained numerous articles, betraying a long sickness, all more or less soiled and damaged by handling. There were many empty bottles, sick-feeders, and tubes and rubber goods, such as air-cushions, ice-bags, and atomizers. The Manager, knowing by long experience what was to come, patiently awaited developments. At last the sad relics of a fatal and expensive disease were all exhibited, and the mourning widow asked at what price they could be sold.

"I am sorry to say, madam," said the Manager, gently, "that we can pay nothing for these goods. They are of no use to anybody."

"But can you not sell them again?" asked the customer, in astonishment.

"We sell only new goods," was the firm reply.

"But who will know whether these goods are new or old, if they are cleaned well and put into new boxes? In fact, some of them have hardly been used at all. By the death of my husband I have been left almost without means, and I think it is rather hard that you should refuse to buy all these appliances, after we have spent so much money here."

"We fully appreciate the value of your custom, madam, and deeply sympathize with you, but that can be no reason to sacrifice the reputation of our business."

"What do you mean by that?" asked the lady, somewhat indignantly.

"You certainly have considered this matter only from *your* stand-point. But now tell me, would you deal with a druggist who you knew bought old articles and tried to sell them to you as new ones, thereby telling or acting a lie?"

The lady made no reply, but a faint blush on her white, care-worn face indicated that she recognized the correctness of the argument.

"Nor is this all," continued the Manager; "such action on our part would not only be a financial mistake, but also a moral wrong, equal almost to crime. There is a possibility that obnoxious bacteria or disease-germs adhere to all the implements that have been used in a sick-room, and may thus be transported to other patients who may use them again. Now, put yourself in the position of a customer who, confiding in the integrity of his pharmacist, would be furnished with an article bearing a concealed but fatal poison! I do not wish to imply that there is any danger in using the goods that you brought in here; but you will see that in such matters we must strictly follow a principle, and no consideration can be strong enough to make an exception."

The sad expression of the mourning customer betrayed her disappointment, and, hardly able to keep back her tears, she packed the articles back in the paper again, saying: "I thought this would help to pay the bill which I owe here for medicine. During the last days of my husband's sickness I was unable to pay for everything. Will you please ask the Proprietor to send me the bill as soon as possible?"

"I believe it is here," answered the Manager, looking through some sealed envelopes that lay on the shelf behind the counter. "It was made out on the first of the month, as is our custom. But, owing to your sad bereavement, it was kept back until now."

"I thank you," said the widow, leaving the store with her child.

The Senior had silently watched the two and listened to their conversation. After the door had closed he burst forth with boisterous voice, in which emotion and indignation were curiously blended.

"I think it is a shame," he said, "to treat the poor widow like that! Why, she spent more than a hundred dollars here during the last two months, and mostly for prescriptions, too! Suppose we cannot use the trash that she brought in here, why did you not make her believe that we could, and give her a few dollars for it? I just felt like giving her a 'fiver' myself, only I did not have any."

"Hush, hush!" said the Manager; "emotion and soft sympathy are bad factors in business. By 'making believe,' as you suggest, we would have done just what I told her we dare not do. She might have told twenty friends about the 'kind druggist' who bought the old articles of her; and the twenty friends would afterwards be suspicious of every sick-room appliance that came from this house. No, sir; do not lie, even for sympathy's sake."

"But think of that poor woman! Here she comes, hoping to save a few pennies, and in place of that she takes away an unpaid bill."

"But it was not an unpaid bill," said the Manager, slyly smiling; "it was a receipt in full."

"How is that?" asked the Senior, in astonishment.

"I will let you into the secret," said the Manager; "but do not tell the 'Old Man,' for he does not like to have such things known. When the bills were made out, we looked over this customer's account, and found that she owed less than ten per cent. of what she had paid during the last four weeks. Knowing her circumstances, a receipt in full was made out, and I was instructed to hand it to her or her child at the first occasion. Now, compare this action with your 'make-believe' theory, and see which is the better."

"Well, that puts another face to it," said the Senior, "and I am really glad of it. But there is my 'ammonia man.'"

The customer to whom this epithet was applied was one of those monomaniacs known in every pharmacy, who will regularly come for a certain article that they imagine to be indispensable for the maintenance of their health or mental equilibrium. They call, according to their particular disposition, every day or once a week, and insist on being waited on by the same person. There is the man who wants two drops of tincture of nux vomica in a little Vichy for his digestion. "I could not live without it; but I prefer to take it here, because I know it is a deadly poison, and I might get used to it if I kept a large quantity at the house. Two drops! never give me any more." Another needs some sodium bicarbonate, twice a day; a third, like the one just entered, wants a dose of aromatic spirits of ammonia; and then there is the man who calls regularly for "some of your best anti-bilious vegetable liver-pills; they are the only ones that help me; it seems nobody else can make them." Then comes the old lady every morning for a glass of sarsaparilla: "You see, my blood is out of order, and instead of taking any of those patent articles, I would rather take yours in soda-water, it is so refreshing and invigorating."

As long as the whims of such people are humored, and even encouraged, they are not only good and regular customers, but also act as voluntary advertising agents, praising their particular pharmacist and his goods as superior to those of anybody else. But as soon as an effort is made to enlighten them, or, what is worse, to ridicule their monomania, they at once become bitter enemies, and abuse and malign the self-appointed apostle of enlightenment wherever they can. It is, therefore, best to quietly give them what they call for, without any comment.

After the "ammonia man," as he was called, had left, the Senior looked for the stock-bottle of Aromatic Spirit of Ammonia to fill up the small dispensing-flask at the fountain; and after he had done so, he found that the stock-bottle was almost empty, and reported the fact to the Proprietor in the laboratory.

"We will make it at once," was the reply. "But before doing so, let us see if we know anything about spirits in general." And turning to the Junior, he continued: "What do you understand by 'spirits' in pharmacy?"

The Junior could give no answer. There was a confused mixture of various spirits in his mind, like spiritus frumenti, spirit of nitre, cologne spirit, peppermint spirit, etc., but he was unable to arrange and classify them.

"What does the word spirit mean, when used in the arts?" asked the Proprietor.

"Alcohol, I believe," was the answer.

"Correct; and by what are the medicated spirits, that you handle daily in the shop, distinguished from each other?"

After a while the Junior answered, with some hesitation: "It cannot be the color, for a good many have no color at all; but they all smell differently."

"And what causes these different odors?"

"Well, I should say different oils that are dissolved in the alcohol."

"Now you have nearly arrived at the general pharmaceutical definition of a spirit,—namely, an alcoholic solution of some volatile substance,—which need not necessarily be an oil, although the majority of spirits are solutions of ethereal oils. We have altogether twenty-five official spirits."

"What percentage of oil is in spirits?" asked the Junior. And the Senior replied:

"The largest amount is ten per cent., contained in Spiritis Menthæ Piperitis and Viridis, Cinnamomi, Anisi, Ammoniæ, and Camphoræ. Then comes Spiritus Chloroformi, with six per cent., and the five per cent. class, represented by Spiritus Aurantii, Gaultheriæ, Juniperi, Lavandulæ, Limonis, and Myristicæ, while Spiritus Amygdalæ Amaræ contains only one per cent. of the oil."

"There is another one-per-cent. spirit," said the Proprietor.

"Yes, sir," answered the Senior. "The Spirits of

Glonoin or Nitroglycerin, which, however, is never prepared in the pharmaceutical laboratory, owing to the dangerous character of the active ingredient. The one per cent. of this new official preparation is determined by weight, while all the oils are measured by volume. Further, we have three compound spirits, composed of a number of oils,—namely, Spiritus Aurantii Compositus, Spiritus Juniperi Compositus, and Spiritus Myrciæ (or Bay Rum); and one compound spirit, made of oils and ammonia,—namely, Spiritus Ammoniæ Aromaticus."

"How about the spirits that contain ether?"

"There are three,—namely, Spiritus Ætheris, an alcoholic solution of 32.5 per cent. of ether; and Spiritus Ætheris Compositus, which contains 2.5 per cent. of ethereal oil, besides the ether. The third ethereal spirit—namely, Spiritus Ætheris Nitrosi—is made by distillation, whereby a chemical reaction takes place at the same time."

"Are any other spirits made by distillation?" asked the Junior.

"Spiritus Frumenti and Spiritus Vini Gallici are made by distillation," replied the Proprietor; "the first of fermented grain, the second of fermented grape-juice. They both contain about fifty per cent. of alcohol."

"We should not forget," added the Senior, "that some of the spirits contain a coloring ingredient besides the oil,—namely, the two spirits of mint, to which peppermint and spearmint herbs, in the quantity of one per cent. by weight, impart a green color; and spirits of lemon, the yellow color of which is produced by five per cent. of lemon-peel."

The Junior, who had taken notes while the Proprietor and Senior had enumerated the spirits, counted them over, and said:

"This makes twenty-four. You said before that there were twenty-five; one must have been forgotten"

"This is the Spirits of Phosphorus, being a solution of 0.12 per cent. by weight of phosphorus in alcohol. If this solution of a non-metallic element is justly called a spirit, we should also call the tincture of iodine a spirit, for it fits the same general definition and has nothing in common with the tinctures. But the dread of changing an old-established name seems to have led the revisers of the 'Pharmacopœia' into this inconsistency."

"There is really little art required in making the spirits," said the Junior.

"With most of them the only requisite is to buy the best of oils and be sure to get no adulteration. The 'Pharmacopœia' gives tests for the detection of spurious additions to most of the oils; but only few pharmacists apply them, depending entirely upon the integrity of the wholesale dealers."

"Cannot most adulterations be detected by the odor?" asked the Junior.

"The average druggist's olfactory organ is but little trained in this direction, and therefore entirely unreliable, and while some people are very sensitive to the sligbest pronounced odor, and can remember and detect it, others are totally indifferent in this respect. There is no doubt in my mind that this sense is susceptible of further cultivation; and the time may come that we will have 'test-odors,' as we now have test-solutions, by which the purity or adulteration of chemicals and drugs can be detected."

"That hardly seems possible," said the Junior, with an incredulous smile.

"There is no telling what may happen in science," said the Proprietor. "Who would have thought a hundred years ago that the eye could be trained by the help of the microscope as it is to-day? The classification of plants rests, to a great degree, on this microscopical training; and forms and shapes of the anthers, the pollen of the minute embryo of the seed, that it would have been impossible to have noticed in former years, are now made the leading characteristics of sub-orders and tribes. And take the organ of hearing. To what perfection in music and harmony has the ear been educated, compared with two or three hundred years ago! Would not our ancestors have ridiculed the idea that a man might converse with a friend a hundred or a thousand miles away? That there is nothing impossible in the attainments of science is taught at each advancing step.

"But now let us return, after this little deviation, to our work, and prepare, *secundum arte*, some aromatic spirit of ammonia."

The Junior opened the "Pharmacopœia" and read the formula, while the Senior brought the necessary ingredients. After mixing ninety cubic centimetres of ammonia water with one hundred and forty cubic centimetres of distilled water, the Proprietor asked the Junior to weigh thirty-four grammes of ammonium carbonate.

"Is this the article required by the 'Pharmacopœia'?" he asked, as the Junior put the weighed quantity before him.

"Yes, sir," answered the Junior, quickly; "I made no mistake in weighing."

"Read what the 'Pharmacopœia' says about it," retorted the Proprietor.

The Junior read: "Ammonium Carbonate, in translucent pieces."

"Stop here," said the Proprietor; "are these translucent pieces?"

"No, not exactly; but I took the powder on purpose to save the trouble of powdering the hard pieces."

"That is the common experience," said the Proprietor; "saving a little labor and spoiling a day's work. You must learn that in our 'Pharmacopœia,' as well as in scientific directions in general, each word has a meaning. Had the powder been wanted, translucent pieces would not have been ordered in the formula.

The fact is, that the official carbonate of ammonium is a mixture of the acid carbonate and the carbonate of ammonium, which, by contact with the air, is partly changed to this white powder,—the insoluble bicarbonate. It is true the ammonia water will again convert the bicarbonate to the carbonate; but to produce this change fully we would need a great deal more of it than the officially prescribed quantity. In future, therefore, consider each word necessary and useful, and make no changes for the sake of a little saving in labor."

The Junior weighed out the carbonate again, this time breaking a large lump and selecting small translucent pieces from the interior. After powdering the necessary quantity in a porcelain mortar, he put the powder into the flask that contained the distilled and ammonia waters, and, closing it, agitated the contents to dissolve the carbonate. Meanwhile, the Senior took a graduate of one thousand cubic centimetres capacity, and put into it ten cubic centimetres of oil of lemon and one cubic centimetre each of oil of lavender and oil of nutmeg. He then rinsed the small graduate in which he had measured the oils with some of the seven hundred cubic centimetres of alcohol that he had measured in another graduate, and finally poured the whole into the litre graduate. To this solution of the oils the solution of ammonium carbonate was gradually added and the mixture agitated. After all this had been done, the Proprietor said:

"According to the 'Pharmacopœia,' this mixture must be set aside for twenty-four hours, with occasional agitation, before filtering. I believe the object of doing this is to convert any undissolved bicarbonate to the carbonate for better solution; but with perfectly good material, such as we have used, this delay seems to be unnecessary."

"Why is this preparation so light,—almost colorless,—while the last portion of it in the stock-bottle was yellow?" asked the Senior.

The Proprietor replied: "Aromatic spirit of ammonia, when exposed to the light, gradually acquires a darker color. The reason for this is not known. It was at first supposed to be caused by oil of pimento, which formerly entered into it, and oil of nutmeg was therefore substituted. But I have not been able to observe any difference. An improvement which appears to me to be more desirable is the replacement of the somewhat unreliable ammonium carbonate by a corresponding quantity of stronger water of ammonia, thereby avoiding the possibility of a precipitate. As only the stimulating effect of the ammonia is aimed at, there seems to be no objection to this change from a therapeutical stand-point, while pharmaceutically it would be a decided improvement."

"Do not the official wines form a subdivision of spirits?" asked the Junior.

"We can hardly say so," replied the Proprietor. "The fact that the wines of commerce are classified as spirituous liquids probably gave rise to this association of ideas in your mind. The official wines are preparations intermediate between infusions and tinctures,—or weak tinctures, if you choose to call them so, meaning weak in alcohol." Turning to the Senior, he continued: "What is the base of our vinous preparations?"

"Vinum Album, white wine," was the answer, "containing not less than ten and not more than fourteen per cent. of alcohol."

"You will therefore see," said the Proprietor, "that the medicated wines of our 'Pharmacopœia' are preparations of varying strength, at least as far as the alcohol in them is concerned; and as different menstrua will dissolve different quantities of extractive matter, the latter will vary also. Which of our wines are solutions of chemicals?"

"Three of them," replied the Senior,—"Wine of Antimony, containing 0.4 per cent. of Antimony and Potassium Tartrate, and fifteen per cent. of alcohol in addition to the white wine; then Wine of Iron, being a solution of four per cent. of Citrate of Iron and Ammonia; and Bitter Wine of Iron, a solution of five per cent. of Citrate of Iron and Quinine. To both the iron wines fifteen per cent. of tincture of sweet orange-peel is added, being equal to nine per cent. of alcohol, and some simple syrup."

"This syrup," added the Preceptor, "is as much as thirty per cent. in the case of the *Bitter* Wine of Iron, and looks like a mockery of the title of the preparation, failing not only to overcome the bitterness of the quinine, but rendering the wine nauseating to many patients. Which of the medicated wines," he continued, "is simply a mixture of a fluid extract and a menstruum?"

"The Wine of Ipecac," answered the Senior, "containing ten per cent. each of fluid extract and alcohol."

"And how are the remaining four wines made?"

"Two are made by maceration,—namely, Vinum Colchici Seminis and Vinum Opii, the latter containing small quantities of Cinnamon and Cloves as aromatics; and two are prepared by percolation, like tinctures,—namely, the Wine of Colchicum Root and that of Ergot. The menstrua of all four are strengthened by the addition of fifteen per cent. of alcohol."

"This ends our list of official wines," said the Proprietor, "that might just as well be dropped and replaced by tinctures with a fixed percentage of alcohol, flavored, if desired, with aromatics, or, in the case of the two saccharine wines of iron, by elixirs."

CHAPTER XV.

ELIXIRS—REVISIONS OF THE "PHARMACOPŒIA"—PROMINENT MEN—ADULTERATIONS.

"WHAT does the word elixir mean?" asked the inquisitive young man.

"It is derived from the Arabic 'eliksir,' the 'philosopher's stone,' by which name for hundreds of years a mysterious object was called which was supposed to possess the power of turning everything into gold. Applied to a liquid, in the Middle Ages, it was what we might call a concentration of all modern quack medicines, a cure-all; and the 'elixir vitæ'—the elixir of life—could not only cure every human ailment, but restore beauty and youth."

"It was used, then, only in works of fiction?" interrupted the Junior.

"By no means," replied the Proprietor; "the most learned men of their times, honest in their researches and utterances, believed in the existence of such a wonderful liquid, and spent years of study, or, rather, experiment, to discover it. The historical fact that Ponce de Leon, the Spanish discoverer, set out purposely to discover a 'fountain of youth' only confirms this statement. Thus the word elixir gradually came to imply something supernatural or wonderful, something that had great undefinable powers, revealed only to the few select, but concealed from the general vulgar understanding. No wonder that in modern times this word was seized upon with delight by the compounders of nostrums; for with many common people it helped to create the idea that the concoctions to which the term was applied were better than official preparations. The object of ancient pharmacists or chemists—of presenting something really remedial or invigorating—was by degrees abandoned, and the modern nostrum manufacturer endeavors to give pleasant taste and elegant appearance to his panacea, often entirely sacrificing therapeutical activity."

"How, then, could such a word get into our 'Pharmacopœia'?" asked the Junior.

"That is easily explained," replied the Preceptor. "The manufacturers of the legion of modern elixirs persuaded the medical fraternity to order their wonderful elixirs, and the pharmacists, of course, were compelled to buy them. This 'working of the doctors' has, during the last twenty-five years, been done so thoroughly that many physicians have entirely forgotten the original meaning of the word elixir,—if they ever knew it,—and believe that it denotes some elegant, palatable vehicle by which the bitter or nauseous taste of certain drugs can be disguised. So they commenced to order elixirs, as vehicles for everything that was unpleasant, leaving it to the judgment of the compounder to make the vehicle as pleasant as he could. This state of affairs naturally brought about a great confusion: the same prescription—calling, for instance, for four fluidounces of elixir of potassium bromide—would be colorless when prepared in one pharmacy, yellow in the next, red in the third; here it would be excessively sweet, and there strongly aromatic, and so on. To correct this uncertainty as to what an elixir is, the revisers of the 'Pharmacopœia' introduced a formula for this preparation, retaining the old name, and stripping it of all claims of being a medicament or healing agent, but using it now for a pleasant aromatic, saccharine, slightly alcoholic vehicle, from which any particular elixir can be made by dissolving in it the active substance. The National Formulary is a very good help in this respect, and gives instructions in all cases where a more complicated manipulation is required."

"Then there is no other elixir official besides the aromatic?" asked the Junior.

"Yes, sir: the Elixir of Phosphorus, a mixture of spirit of phosphorus, oil of anise, glycerin, and aromatic elixir, the glycerin representing more than one-half of the whole preparation. This formula was probably added on account of the dangerous nature of phosphorus, so as to guard it against the possible dangers of empiricism."

"You often speak of the revisers of the 'Pharmacopœia,' said the Junior, changing the subject; "and

I have often thought who these men might be, and why the 'Pharmacopœia' should need a revision."

The Proprietor replied: "Pharmacy and medicine are continually progressing; new plants or elements, or new properties of old ones, are discovered; former processes of preparing compounds are supplanted by better or less expensive ones; mistakes in applying certain remedies and over- or under-valuation of the power of some drugs are detected; new preparations must be added from time to time, and old ones dropped. These are some of the reasons why a revision of our pharmaceutical law-book becomes a necessity, and ten years has been agreed upon as the time between the revisions. In monarchical countries the ever-provident government appoints the revisers; but in our republic the two professions interested in this cause must do the work. The medical and pharmaceutical societies and colleges select their delegates, who meet, deliberate, propose, and amend, appoint committees to make investigations or to examine into the virtues of newly proposed drugs, and thus, as the result of many years' labor, a new revision of our 'Pharmacopœia' appears."

"How much a man must learn and know to be fit for such a position," said the Junior, "and how few in our profession will reach such prominence! I am sure I will never be able to 'get there.'"

The Proprietor smilingly replied: "Your admiration of learning is as pleasing as your modesty is commend-able. But you need not despair. There is no reason why you should not some day be called upon to help in the revision of our book or in other equally important work. Many men whose minds and learning reflect from the pages of the last excellent edition of the 'Pharmacopœia' commenced their pharmaceutical careers under more difficult and unfavorable surroundings than you."

"Did they?" exclaimed the Junior. "I thought only men of long college experience—men who had done nothing but read and study all their lives—would be selected."

"If practical men had not helped to make the 'Pharmacopœia,' it would not be what it is," replied the Proprietor. "But to enlighten you on the early careers of some of the prominent men in our profession, I will narrate to you what one of them told me some time ago about his early life as a pharmacist. I will use his own words as far as I can recall them. He said: 'When I entered the drug-store as apprentice, not much was known of what we call "elegant pharmacy" to-day. My preceptor was a rather plain man, without much education or refinement. His business included everything that could be found in an old-fashioned country store,—from shoestrings to anvils, from pins to crow-bars; and the drug department was kept in the background. There were five rows of shelves about ten feet long, and, underneath, a number of drawers; near by was a plain table, with a few graduates, a mortar, a crude balance and worn-off weights, and a pail of water for washing bottles, that I had to refill twice or three times a day from a well half a block away. Here I got my first instruction, or, rather, scolding; for the owner knew very little about drugs, and tried to hide his ignorance behind some big words and coarse language. But that little corner was to me a real paradise. Drugs had a wonderful attraction to me, and if I say that I looked upon those dirty bottles and their labels with veneration, it is but partly expressing my feelings. Very soon I had examined and tasted every article that was kept in stock, and was one day pronounced a great expert when I declared that some crumbled remnants of a drug of which a customer wanted to buy more were rhubarb, judging by the taste. The Latin names on bottles and drawers interested me particularly. I was not satisfied to know that "Pulv. Rhei" stood for powdered rhubarb, or "Tr. Opii" for laudanum; I wanted to know more about them. Now, my employer ridiculed all efforts at information or education; but he could not deter me. The only time at my disposal was an hour after dinner, when there generally was no business and the owner took a nap. Among the few books that this dealer possessed, I had found an old "Materia Medica," and a book without a title-page, which I would now call a first attempt at a "Dispensatory." These two books formed my library. I myself had received no instruction beyond that which a small country school at the cross-roads between four hamlets could impart during the winter months, when the boys were not wanted by their fathers in the field or garden, and I had to invent my own way of gathering information. If my preceptor—excuse the name—would see me with the books, he would scold me and even threaten to burn them; so that my studying had to be done stealthily. This is the way I went about it: I cut slips of pasteboard that fitted into my vest-pocket, and on each one I wrote all the information I could get about a drug, commencing with the first bottle, and continuing as I found them on the shelves, without any system whatever. For instance, there was Tr. Opii. The Latin name written in full was the heading on my slip. Then came the English name, the plant from which it was derived, the dose, antidote, and mode of preparation. The natural orders my books did not mention, nor the shape of leaves, fruits, stems, or roots; in fact, nothing at all of vegetable morphology; and it was left to my own imagination to depict my idea of the plant. I remember that for years I thought that opium grew on a tree, under which my fanciful imagination saw the unfortunate victims that had, unconscious of their danger, looked for rest in its shade and inhaled its deadly odor. Sometimes I added remarks, giving my own experience or observations regarding the drug. For instance, under laudanum, there was the note: "John Brown says that a teaspoonful, given by mistake, killed his baby;" or, "John Smith bought two ounces to kill an old dog." We may smile at this crude and unsystematic way of gathering information; but to me, without the necessary previous education, the compiling of such data on a small slip was as much work as the writing of a scientific essay is to a scholar. And wasn't I proud of my collection of memoranda! Never did an Egyptian priest guard his papyrus rolls with greater veneration and pride than I watched over these pasteboard slips. I always carried some in my pocket, and whenever opportunity offered, memorized or recited, when sweeping the cellar, running on errands, rocking the baby, grooming the horse, or washing the wagon. It was an odd and hard way of entering into the mysteries of pharmacy, but a fruitful and successful one; and even to-day, while the walk through life lies before me like a pleasant, easy journey, I recall with pleasure and satisfaction those days of my apprenticeship, and their recollection has often been a soothing medicament in the turmoil and worry of later enterprises and disappointments.'

"And this man," continued the Proprietor, "beginning so modestly and under such unfavorable circumstances, is to-day one of the leaders in pharmacy. He was called to the chair of a pharmaceutical college, he has received the highest honor that American pharmacy can bestow on her faithful sons, and science owes many valuable essays and investigations to his clear and productive mind. If he could reach this goal, why cannot you? Set a noble purpose before you, and make it the object of your life; subordinate to it all wishes, desires, or temptations that may approach you, however seducing or glittering they may be, and believe me, honestly following this purpose, with integrity in your heart, you will some day be a leader in your profession, honored and respected by all."

"I beg your pardon," interrupted the Manager, who had come in from the store, followed by the Senior; "a customer left this bottle with us, and asked us to tell him whether it contained pure chloroform or a mixture of chloroform and alcohol. He said he bought it in the mountains, where he spent some days for the purpose of collecting butterflies and other insects, and suspects that it is not pure chloroform. He will be back in a few minutes."

At the same time he handed the Proprietor a partly filled bottle labelled "Chloroform."

"Well, what can we do about it?" asked the Proprietor, looking at the undetermined faces around him. As no one answered, he continued: "Whenever we wish to detect an adulterant in a liquid drug,—and especially when we know what this adulterant is,—we should ask ourselves whether, by adding a third liquid, we cannot separate the first two. You know that by adding water to spirit of peppermint a milkiness is produced, which consists of finely divided particles of oil of peppermint; the water mixes with the alcohol, and this mixture is not able to hold all the oil in solution. Now, who can suggest anything similar in the case in question?"

"Put water to it," said the Senior; "it will mix with the alcohol, while the chloroform will drop to the bottom." At the same time he took the suspected chloroform in one hand, and, putting the other on the hydrant, started to fill it with water.

"Use care and discretion," said the Proprietor, interfering. "Suppose this test should prove a failure, you would have nothing left for further experiments; nor is it necessary to destroy the customer's property entirely for the sake of the investigation. Take fifteen cubic centimetres of it and put it in a bottle of one hundred and twenty cubic centimetres capacity; now almost fill the bottle with water, leaving room enough to allow shaking; then shake violently for some time, and pour the liquid into a graduate, allowing it to stand a while. If the chloroform is pure, there should be almost fifteen cubic centimetres of it at the bottom. But what do we notice?"

After watching the liquid for a while, the Senior said: "Why, there are less than seven cubic centimetres of chloroform in it; therefore eight cubic centimetres must have been alcohol."

"Not quite," said the Proprietor; "the supernatant mixture of water and alcohol will hold a little chloroform in solution. But in testing it is always good to use two tests, based on different properties of the drug. We can easily apply a second test by determining the specific gravity. Dry this graduate thoroughly," he continued, handing the Junior a ten-cubic-centimetre graduate, "and balance it on the scale. This done, pour into it carefully ten cubic centimetres of the suspected liquid and weigh it. The specific gravity of chloroform in the temperature of this room is about 1.475, and ten cubic centimetres, therefore, should weigh 14.75 grammes."

The Junior did as told, all eyes watching him.

"It weighs only 11.460 grammes," he said.

"Now, let us suppose," explained the Proprietor, "that from our first test we were justified to call this a mixture of equal parts of alcohol and chloroform, and calculate how much such a mixture would weigh. There are five cubic centimetres of chloroform of a specific gravity of 1.475; they weigh $5 \times 1\,475$, or 7.375 grammes; and five cubic centimetres of alcohol of a specific gravity of 0.817 would weigh $5 \times .817$, or 4.085 grammes, and adding 7.375 and 4.085, we have 11.460 grammes, or the same as the actual weight of the liquid as you found it. Judging by these two tests, you may tell the customer that the liquid is a mixture of equal parts by volume of chloroform and alcohol."

"Thank you," said the Manager, returning to the store.

CHAPTER XVI.

SPECIFIC GRAVITY—THE POUND—DETERMINING SPECIFIC GRAVITY—ADHESION—HYDROMETER.

"I DO not fully understand," said the Junior, "how this test by specific gravity was made; in fact, I know very little about specific gravity, and would be thankful for some further information on the subject."

"To comprehend the subject of specific gravity or specific weight," replied the Proprietor, "which seems to be so troublesome to many beginners, let us first understand what is meant by 'gravity' or 'weight.'" And seeing that the Junior could not answer, he continued; "Why do things like meat, iron, or bricks weigh?"

The Junior thought a while, and the expression of his face indicated that he was not much pleased with the question. Then he said: "They weigh because they press the scale-pan down. Everything has a certain weight; we all know that. I do not see that any explanation for it should be needed."

The Proprietor replied: "How often have we occasion to observe that facts or phenomena of every-day occurrence are considered, by the thoughtless, to need, and to have, no explanation! It was this quiet approval to everything in the surrounding nature without deliberation and effort to search for truth that characterized the dulness and thoughtlessness of the Middle Ages; while to-day enlightenment on every subject and the instigation to think and to really know are the main principles of education. It is much more important for a man's welfare and success to be trained to stop and think at every step he takes, than it is to memorize and repeat parrot-like the investigation of others. Let us see if you cannot be made to correct your quick and ill-advised declaration by rational thinking. You say that all substances press on the scales. Now, tell me, do they press only on the scales?"

"Of course not," replied the Junior; "they press wherever they are put."

"What, then, seems to be their tendency, their desire, if I may use this term in connection with inanimate objects?"

"They all want to drop to the ground."

"Precisely; and would they stop there if nothing interfered? For instance, what do stones do that are put on the surface of the ocean?"

"They sink to the bottom, of course," replied the Junior.

"And how much farther would they go if there was no bottom?"

After a few seconds the Junior's face brightened, as if he had been inspired by a sudden revelation, like a bright sunbeam breaki g through the clouds.

"I see what you are driving at," said he. "It is the attraction towards the centre of the earth that makes things weigh."

"Certainly; and it is the force of this attraction exercised on a body that constitutes its weight."

After a second the Junior asked, with some hesitation:

"Is not the attraction of the earth the same at all times and places?"

"Certainly it is."

"Should not, then, all bodies weigh alike if they are attracted alike?"

The Proprietor answered: "While the attraction, as such, like all forces of nature, is equal everywhere, and extends its power indiscriminately on all bodies, it exerts itself with the more energy the closer together the molecules of an object are, or, as we call it scientifically, the greater its density is; as in the case of iron or gold, in comparison with wood or cloth."

"That is, then, what we call weighing 'light or heavy,'" said the Junior.

"Yes, sir; and now tell me what means we have of measuring this attraction of the earth, or gravitation of all bodies?"

"We weigh the object and express its weight in pounds or ounces."

"What, then, is a pound?"

"It is the unit of weight with which all other weights are compared; it is generally represented in practice by a piece of iron or brass of a definite weight."

"This unit originated with the weight of a grain of wheat of average size; and even to-day we call our smallest unit of weight a grain. Seven thousand of these grains form a pound, avoirdupois, which, for the sake of convenience, is generally represented, as you said, by a corresponding piece of brass or iron. In the metric system the gravity of a cubic centimetre of distilled water is made the unit of weight, as you know. Let us now take another step. If we compare objects by weight, a pound or a kilogramme—whatever unit of weight we adopt—will vary in volume, according to the density of the respective substance. Thus, a pound of butter is more bulky than a pound of iron, etc."

"Such a comparison is not very convenient in scientific investigations, owing to the different volumes which cannot easily be measured, on account of the irregular shape of most bodies. If all objects were exact squares or spheres, there would be less difficulty; but such is not the case. It is, therefore, natural that a desire must have arisen with early investigators for a different comparison,—one based on equal volumes of the substances compared. Some time ago, when I explained the metric system to you, I used this little hollow cube."

"I remember it well," said the Junior; "it represented the cubic centimetre, and the weight of that cubeful of water constitutes the metric unit of weight,—the gramme."

"So it does," continued the Proprietor. "Now, imagine that we had a great many of such little cubes made of different materials,—wood, iron, gold, etc.; others made hollow and filled with liquids,—water, alcohol, chloroform, the different oils, etc. Then, by weighing these cubes and comparing their weights, we would obtain a list of figures indicating how much heavier or lighter a volume of one substance is than that of another. For instance, if we found the cube of iron to weigh seven grammes and that filled with mercury to weigh fourteen grammes, we would say that mercury is twice as heavy as iron; and so on. Such a comparison of the weights of equal volumes becomes, however, more comprehensive and useful if one substance is made the unit and all others are compared with this same unit. For this purpose water has been universally accepted, and forms the standard of specific gravity; in other words, all scientists have agreed to designate the specific gravity of water as 1, and to distinguish that of any other substance by comparison with this unit. If you hada cubic centimetre of iron, for instance, you would need seven and eight-tenths cubic centimetres of water to balance it on the scales; you therefore say that the specific gravity of iron is 7.8; and so on."

"Then the specific gravity of any substance," interrupted the Junior, "is the weight of one cubic centimetre of the substance expressed in cubic centimetres of water."

"Exactly. But as you see that only the ratio of the two weights is wanted, it is immaterial whether we take just a cubic centimetre of each substance or any other volume, so long as the two volumes compared are alike. We might just as well compare a litre of water and a cubic decimetre of iron; or a cubic metre of each, or a thimbleful, or a pailful; the ratio of the two weights will always be 1 : 7.8. The definition of specific gravity is, therefore——"

"I know," exclaimed the Junior; "let me tell you. The specific gravity of a substance is its weight in comparison with the weight of an equal volume of water."

After a while the Junior continued:

"In order to find the specific weight of different substances, is it necessary to cut or manufacture pieces of known capacity?"

"Not at all," replied the Proprietor. "I only started my explanation with the imaginary cubes for the sake of illustration. I will now proceed to show you how this specific gravity can be determined, and how easily it can be done with hardly any apparatus. Let us first consider liquids. We can easily measure equal volumes and then weigh them. For this purpose so-called 'specific-gravity' bottles are constructed,—bottles with a perforated glass stopper. After filling the bottle with a liquid to the top, the stopper is inserted, forcing by its weight some of the liquid through the hole, and thus enabling the operator to measure always the same quantity. I have no such bottle here, but it is easy to construct one. Let us take this small flask and insert into its neck this perforated rubber stopper, through which we put a small piece of glass tubing, projecting about half an inch. We first ascertain the combined weight of this flask, stopper, and tube, which, as you see, is forty-five grammes. We now fill the flask with water to the very top, and press the stopper down as far as it will go. You see that some of the water runs out of the upper end of the small tube. We now dry the bottle carefully and weigh it again. Its weight is now 110.5 grammes. Deducting forty-five grammes, the weight of the apparatus alone, leaves 65.5 grammes as the weight of the water contained in the bottle. We now pour the water out and dry the bottle."

To do this properly, the Proprietor took an alcohol lamp, and held the empty bottle over it, turning it around, so as to volatilize all the water adhering to the inner surface. Then he continued:

"Now let us try to find the specific gravity of chloroform. We will fill the bottle with chloroform, insert the stopper, wipe dry, and weigh. This time the combined weight is 141.87 grammes; from this we deduct the weight of the apparatus (forty-five grammes), which leaves 96.87 grammes as the weight of the chloroform. We found before that the same volume of water weighed 65.5 grammes; therefore chloroform weighs as many times as much water as 65.5 is contained in 96.87, which is 1.479. In other words, the specific gravity of chloroform is 1.479. Now try the same experiment with alcohol."

The Junior emptied the bottle, and, after drying it, filled it with alcohol, proceeding in every particular as he had been shown. At the end of the experiment he said: "Weight of apparatus and alcohol, 98.4 grammes; weight of apparatus alone, forty-five grammes. Therefore the weight of alcohol alone is 53.4 grammes; and this figure, divided by 65.5 (the weight in grammes of an equal bulk of water), gives 0.815, the specific gravity of alcohol."

"By comparing these calculated figures—namely, 1.479 and 0.815—with those given in our 'Pharmacopœia' as the specific weights of chloroform and alcohol, respectively, you will see that our answers are nearly correct. I will add that the regular specific-gravity bottles are constructed to hold exactly ten or one hundred cubic centimetres, so that, after finding the weight of the second liquid, we need to cut off only one or two decimals, instead of dividing by 65.5, as we have done; for you know that ten cubic centimetres of water weigh exactly ten grammes, and so on."

"I do not quite understand," said the Junior, "why it should be necessary to put the stopper with the tube, or a perforated stopper, in the neck of the bottle.

Why could not we simply fill the bottle to the top?"

"I am glad you ask this question," replied the Proprietor; "and the very best way to find an answer will be to let you try the experiment without a stopper. First, fill the bottle with water."

The Junior did as directed. "I think it is full now," he said.

"Is it, indeed?" said the Proprietor, taking a small medicine-dropper, filling it with water, and dropping from it a drop on the surface of the water in the bottle. "It must be over-full now," he said, "but it does not run over." Another drop followed the first one, a third and a fourth were added, and so on up to nine drops.

The Junior, a little puzzled, watched the surface carefully, and said: "The water is bulging up in the centre."

"So it is," replied the Proprietor; "there exists a certain attraction between liquids and solids, called 'adhesion,' which makes the glass hold on to the water, keeping it from running over, until the pressure of the small elevation of liquid becomes greater than the power of adhesion. But, owing to this same adhesion, you will at once understand how difficult it is to exactly fill a bottle, and, if it was filled properly, how carefully it must be handled to avoid spilling. The insertion of the stopper and tube overcomes this difficulty to a great extent, because the exposed surface at the end of the tube is so very small that the possible discrepancy would be less than a drop.

"I will show you," continued the Proprietor, "how we can use this home-made specific-gravity bottle, even for solids. For instance, we wish to find the specific weight of iron, taking this little nail to operate with. I first ascertain its weight, which is 1.31 grammes. Now I put it into the bottle, and fill the bottle with water, as before. The complete weight is 111.63 grammes. Deducting from this the weight of the apparatus (forty-five grammes), leaves 66.63 grammes as the weight of the water and iron. Deducting from this the weight of the iron, 1.31 grammes, leaves 65.32 grammes as the weight of the water alone. You know that we found before that the water weighed 65.5 grammes. Why does it weigh less now?"

"Because there is not so much of it."

"How much less is there?"

"65.5 minus 65.32 equals 0.18 gramme."

"How much less is there in bulk?"

"As much as the piece of iron displaced."

"Correct; therefore 0.18 gramme represents the weight of a bulk of water equal to the bulk of iron."

"Oh, I see!" exclaimed the Junior; "we now divide 1.31 by 0.18, and the quotient—7.28—is the specific weight of the metal."

"So it is."

"But did you not say before that the specific gravity of iron was 7.8?"

"Yes, sir; but this difference is easily explained," said the Proprietor. "In the first place, this nail is not pure iron, but iron mixed with a certain percentage of carbon. In the second place, experiments of this kind cannot make any claim to scientific correctness, for which much more care, finer apparatus, and a greater number of successive experiments are necessary. The temperature should also be taken into account. But the object of these experiments is not to revise or verify investigations of others, but only to show you the method of reaching such results. Now find the specific weight of zinc."

The Junior took the small, irregular piece of sheet-zinc that his preceptor handed him, and repeated the preceding experiment. Then he reported the weight of the zinc alone to be 2.36 grammes, and continued: "Weight of the bottle, water, and zinc, 112.53 grammes. This, minus the weight of the bottle (forty-five grammes), gives us the weight of the water and zinc, 67.53 grammes; this, less the weight of the zinc (2.36 grammes), gives us the weight of the water in the bottle, 65.17 grammes; deducting this from 65.5 (the weight in grammes of the bottle full of water), leaves 0.33 gramme as the weight of the displaced water. Dividing 2.36 (the weight in grammes of the zinc) by 0.33 gives 7.15 as the specific gravity of zinc."

After a while he remarked: "Suppose, now, that I wished to find the specific weight of alum, would not the water dissolve a part of it during the experiment?"

"In case of a soluble substance," answered the Preceptor, "we first compare that substance with a liquid in which it is not soluble,—for instance, alcohol or turpentine,—and afterwards calculate the weight of an equal bulk of water; for the specific weights of alcohol and water must be in the same proportion as any given volume of alcohol is to an equal bulk of water. For your own instruction, you must try this experiment later, and report the result or any difficulty that you may find."

"Now one more question," said the Junior. "Suppose the substance floats in the water?"

"In that case," replied the Preceptor, "attach a heavy body to it, so that it will sink. For instance, take this small cork. First take its weight. Then put through it this nail of known weight. We also know the weight of the water displaced by the nail alone. Now ascertain the weight of a bulk of water displaced by the cork and nail, and subtract from it the weight of the water displaced by the nail alone, and the difference will be the weight of a bulk of water equal to the bulk of the cork. Then proceed as before."

"Is there any other method of finding a specific weight? For instance, I might have a valuable article, of which I would not like to cut a small piece that would fit in the bottle."

"In such cases we make use of another quality of all substances,—namely, the loss of weight on immersing in water."

"I remember," said the Junior, "that I once heard a definition of specific gravity in which this loss of weight was mentioned."

"Yes, sir," answered the Proprietor; "specific gravity is sometimes described as being the proportion of the weight of a body to its loss of weight in water. While this definition is scientifically correct, it is confusing to the beginner, because it is based on a property of all matter which in itself has nothing to do with specific gravity, but is only used to find the specific weight of solids. This is done in the following manner: If we weigh any article,—for instance, this piece of iron, representing one hundred grammes, —first in the ordinary manner, and afterwards by suspending it from one pan of the scales and letting it hang in a graduate filled with water, which we place under the scales, we will notice that it weighs less the second time. You see that this 100-gramme weight weighs only 87.5 grammes now, and the loss of weight is therefore 12.5 grammes. Dividing 12.5 into 100, we have 8, the specific weight of iron."

"According to this definition," said the Junior, after a short reflection, "12.5 represents the weight of an equal bulk of water."

"Certainly; what else could it represent? It is a self-evident truth that no two bodies can be in the same place at the same time, and that if one substance wishes to take the place of another, it has to use force, or push the other aside, as the piece of iron does the water. But this same property is also possessed by the water, which therefore resists; you might say it pushes back in trying to throw the foreign body out. In this effort it will partly succeed whenever the intruder is light, like cork; while a heavy body, like iron, remains unmoved. In applying this general property of matter to the determination of specific gravity, you will see that we can only use it for solids."

"You showed me before," said the Junior, "how we could detect an adulteration of chloroform by means of the specific weight. Cannot the same method be applied to other liquids?"

"Why, certainly; and it is done very often. Take, for instance, alcohol, of which such enormous quantities are used in the arts. It would be very easy to sell alcohol adulterated with water, if it were not for the change of its specific weight. Easier methods, however, than the one that we used are employed for this purpose. A glass tube with a bulb at one end, similar to the tubes used for thermometers, is arranged by a weight,—for instance, a little mercury put into the bulb,—so that it will float in pure alcohol, the tube partly projecting out of the alcohol. The point on the tube where it projects is marked zero, meaning no water. Now add one per cent. of water to the alcohol, and again float the tube; the liquid, having now a greater specific weight, the instrument, of course, displaces a little less of it, and the tube projects a little higher out of it. Mark the projecting point 1, meaning one per cent. of water. Then add another per cent. of water, and repeat the operation, marking the projecting point 2, and so continue until you have reached 100, meaning one hundred parts of water and none of alcohol. Such an instrument is called a hydrometer, or water-measurer; or, if it is arranged to measure the percentage of alcohol, an alcoholometer."

"Are there not similar instruments for detecting adulterations in other liquids?"

"Certainly," replied the Proprietor; "we can construct such a meter for any two liquids that we desire. Those most commonly in use, based on the varying specific weight of a mixture of the respective liquid with either water or solid ingredients dissolved in it are the lactometer, or milk-measurer; the saccharometer, or sugar-measurer; and the urinometer."

CHAPTER XVII.

PREPARATION OF PILLS — POISONS—EXCIPIENTS—PILL-ROLLERS — NICKNAMES — CAPSULES — PILL-MASS—LAZINESS.

After these words, the Proprietor returned to the prescription-counter, where he saw some prescriptions, and, being told that the owner would call later for them, he called the Junior to read the first one. The Junior read:

"Acetanilidi,
Quin. Sulph., āā gr. xxx;
Pulv. Capsici, gr. x;
Strychn. Sulph., gr. ss;
Acidi Arsenosi, gr. i.
Misce et ft. pilulæ No. xxx."

"How would you proceed to compound it?" said the Proprietor.

"Well, I would put all the ingredients in a mortar and mix them."

"In what order?"

After a moment's reflection, the Junior said: "I do not think it would make any difference in what order we mix them."

"And yet it does," replied the Proprietor. "When you have various ingredients to mix in powder form, you must first examine when they can be powdered best,—before or after mixing; and with few exceptions they can be powdered better before mixing. If you add the acetanilid—which comes to us in small scales—to the powdered capsicum, you will not only experience great difficulty in powdering, from the fact that the somewhat elastic particles of the capsicum embed and protect the small scales of the acetanilid and keep them from being broken into smaller fragments by trituration, but the dust arising in consequence of the agitation of the powder will be a disturbing element, causing violent sneezing, and thus delay the operation. Therefore, make it a rule to powder each ingredient separately—if necessary, in a separate mortar—before mixing. Now weigh out the acetanilid and begin the operation."

The Junior proceeded as told. Then he looked inquiringly at his Preceptor.

"Another important thing in preparing pills," continued the Proprietor, "is to have the different ingredients well mixed, and this is all the more necessary when such potent drugs as arsenous acid and strychnine form a part of the prescription. By carelessness an overdose of either of these might be put into one pill, and serious results follow therefrom. Add now the arsenous acid, using this finer prescription-scale to weigh it."

The Junior put the one-grain weight on the scale-pan, and then opened the small poison-closet, in which all powerful drugs were kept. It was so arranged that a bell rang every time it was opened, thereby calling the operator's attention to the possible dangers to which carelessness might expose him and his customers. The arsenous acid, which was kept in powder form, was soon weighed; and the Junior then turned to strychnine, but hesitated before taking the container from the shelf.

"You notice," said the Proprietor, "three different bottles with strychnine: one small one, containing one-eighth of an ounce, as we buy it from the manufacturer, and two larger ones, with red labels, on the larger one of which is plainly written 'Trituration of Strychnine Sulphate, 1 : 16;' and below this, 'Sugar of Milk, 15 parts (by weight), Strychnine Sulphate, 1 part;' and on the other vial, in the same way, '1 : 10.' The object in keeping these bottles is to facilitate weighing. We often receive prescriptions calling for one-eighth, one-tenth, or one-sixteenth grain, or even less; and, although our scales are sensitive to one-sixty-fourth grain, I generally prefer to use these triturations to reduce the possibility of a mistake. Instead of one-eighth grain, we would then use two grains, multiplying the prescribed quantity by sixteen. If the subdivisions are made to tenths, we use the 1 : 10 trituration."

"Is not this second trituration official?" asked the Senior.

"The 'Pharmacopœia' gives a general formula for triturates, and as an illustration the trituration of

Elaterin, adopting the proportion of one part of the active substance to nine of Sugar of Milk. I consider it very fortunate that these triturations have been added to the list of our 'Pharmacopœia,' so as to establish uniformity in their preparation, although other proportions may be adopted whenever a need for them is established."

"Then we must use eight grains of this trituration for our prescription?" asked the Junior.

"We would, if we wished to use it," replied the Proprietor. "Half a grain, however, can easily be weighed."

The Junior weighed the Strychnine, closely watched by the Proprietor; and, after putting it into the mortar, waited for further instructions.

"We will not use the poison-closet any more for this prescription," said the Proprietor; "therefore, after convincing yourself that each article has been put into its proper place, close the cabinet. Also wipe the scale-pans and close the glass doors of the casing of the delicate scales, to prevent dust from entering. Now triturate the arsenous acid and strychnine sulphate well with the acetanilid, and afterwards add the quinine. Finally, add the capsicum, agitating again, but more gently than you did before, to keep us from sneezing.

"We have now before us in powdered form the active ingredients of the pills. But pills consist of two parts,—the active ingredients and the excipient, by which latter is meant a substance that imparts the proper consistence to the powder mixture or converts it into a mass.

"Sometimes one of the ingredients forms a proper excipient; for instance, when a solid extract, like that of henbane or dandelion, is ordered. Sometimes the physician prescribes the excipient; but in most cases the selection of the excipient and the determination of the quantity are left to the pharmacist. For this purpose you see here two bottles, one containing a powder, the other a viscid liquid. The first is a mixture of one part of acacia, two of tragacanth, and two of sugar,—a combination of adhesive materials which, by long experience, I have found to be exceedingly serviceable. It is used whenever the prescription calls for ingredients that are moist or deliquescent; the powder absorbs the moisture and readily forms a mass. The other preparation—the liquid—is a solution of the powder in a mixture of four parts of glucose and one of glycerin; one per cent. of benzoic acid as a preservative is added. It forms an excellent excipient for dry powder mixtures, such as ours. Occasionally the addition of a few drops of water is useful, when the powder has great absorptive powers, as is the case with rhubarb. The glycerin in the excipient keeps the pills from getting so hard that they cannot easily be dissolved by the intestinal juices, as pills will do when prepared only with acacia and water."

The Junior added a few drops of the liquid excipient to the powder, and, after brisk agitation, succeeded in making a plastic mass of the proper consistence, and gave it a cylindrical shape with the hands. He then put it on a porcelain pill-tile, with a scale divided into thirty equal parts, and proceeded to roll it out to the length of the scale by means of a large spatula.

"I am glad," said the Proprietor, "that you pay proper attention to the thickness of the mass, which must, of course, be uniform in every part. Some operators use a roller, which is a smooth piece of wood about six inches square, provided with a handle; others only use their hands; and machines have also been constructed to insure perfect uniformity of the long, thin cylinder to which the mass is rolled out. The next operation is to place this cylinder alongside of the scale, and, with a thin spatula, cut it into thirty equal parts. The rounding of the parts is best done with the fingers.

"In this manipulation experience is the only teacher, and it cannot be expected that a beginner will prepare such a preparation as quickly as an old pharmacist. The rounding can be perfected by rolling the pills finally under this pill-finisher,—a round, plate-shaped piece of wood of about three inches diameter, hollowed out to a uniform depth."

"Shall I now put them into the box?" asked the Junior.

"It will be better to roll them once more under the finisher with a little rice flour, to prevent them from adhering to one another or to the box. For this purpose I consider lycopodium the best powder; but, owing to the white color of the pills we just made, rice flour is preferable in this case. We now put the pills into the box, and they are ready for dispensing."

"Pill-making," said the Junior, "seems to me one of the most difficult tasks of our profession, and I do not wonder that we are often called 'pill-rollers,' although it always makes me mad."

"Well, I did not think you were so sensitive," said the Senior, who had meanwhile prepared another prescription, calling for ten large capsules. He put the box containing the capsules on the counter in front of his Preceptor, with a decided gesture of pride, as if to say: "Look at this; I made these without any instruction, and yet they are perfect!"

The Proprietor took the box, opened it, and glanced at the prescription, which had been placed under the box, as was the rule in this pharmacy whenever a medicine was finished. A faint cloud of displeasure darkened his face for a second, when the Senior, expecting a word of approval or praise, could no longer restrain himself, and said: "Are they not fine? Shall I write the directions and wrap up the package?"

"When will they be called for?" asked the Proprietor.

"In an hour or two," was the answer.

"Then let them stand here for a while; there is time enough to file the prescription." And, turning to the Junior, he added:

"You said before that the epithet 'pill-roller' displeased you when applied to yourself. Now tell me the reason for your emotion."

"Well," said the Junior, "it is mostly said in a tone of derision or contempt; and those who call us by that name generally wish to indicate thereby that they consider us a ridiculous set of men, or cranks; and they often accuse us of charging exorbitant prices and of taking advantage of the misfortunes of the sick to enrich ourselves. Even the daily press hacks at us, and spreads all kinds of adverse reports about us and our business that are exceedingly annoying. Only the other day I saw an article in a Sunday paper, in which a reporter gave his experience in pricing a certain prescription in twenty drug-stores, where he was charged twenty different prices; and then he figures out the actual cost of the ingredients, and went on to show that we ask a profit of five hundred per cent.! All such talk and writing makes me feel like quitting pharmacy and going in some other line of business."

"Well, that is quite a long list of crimes charged against your pharmaceutical greatness," said the Proprietor, ironically. "You should, however, learn to listen to the criticism of your fellow-men with composure, and to rather consider such criticism the answer of an echo to your own words and deeds. If you speak and act cautiously, courteously, and intelligently, the echo will be in the same tone; but if you scold like a wicked boy, the echo sauces back and vexes you. And why should you be angry if others call you what you really are,—a pill-roller or poison-mixer? In fact, if we have any reason for taking exception to that appellation, it is that large establishments and labor-saving machines have taken from us much of our former occupation, so that pill-rolling is, of necessity, practised less in the shops nowadays than formerly. Be proud of your work! Nothing ennobles you more than the faithful performance of your duty; and it is much more honorable for you to be called an excellent pill-roller than a smart 'soda-water clerk,' with a suggestion of 'bar-keeper' in the title. There are many instances on record where nicknames or contemptuous by-words became the battle cries of powerful political or religious parties. There were the inmates of a certain convent nicknamed 'Capuchins,' on account of the hood that they wore; and this name was retained for the order that afterwards became, as you know, one of the most powerful religious organizations that ever existed. It was the same with the 'Whigs' in England and with the 'Huguenots' in France; and, as an example from modern times, I may cite the much-abused 'Mugwumps,' who cast the deciding vote in several Presidential elections. Therefore, don't worry about the 'pill-roller;' and as to exaggerated newspaper reports, we all know that the press of to-day hunts for sensational stories, but the intelligent reader takes such 'penny-a-line' reports 'cum grano salis.' In times of compulsory economy, like ours, pricing merchandise before buying is a common custom; and if the reporter would call at twenty different shoe-stores for the price of a pair of shoes, he would probably obtain a similar result. Professional skill, however, does not come under the head of common merchandise; it is each man's own property, for which he can charge whatever he pleases. Not only the pharmacist does so, but also the doctor, the lawyer, the architect, and others; and if your skill is actually worth more than that of your neighbor, the public will soon discover this fact, and willingly pay you more for it. Therefore let not unjust criticism annoy you; rather show how good a 'pill-roller' you are by preparing this prescription."

With these words he took a small pill-box that had been left for renewal of the contents, and looked for the corresponding prescription on the file. It read as follows:

Aloes, 2;
Asafœtidæ, 1.5.
Ft. pil No. xx, pulv. cinnam. convol.

"That does not seem difficult," said the Junior; "only I do not understand what is to be done with the cinnamon."

"Written complete, the directions read, in Latin, 'Fiant pilulæ numero viginti, pulvere cinnamomi convolvendæ;' or, in English, 'There are to be made twenty pills, to be rolled in cinnamon powder.' "

"Oh, I see; to disguise the unpleasant taste," said the Junior. "I first weigh the ingredients: aloes, two grammes. But what kind of aloes shall I take?"

The Proprietor replied: "In a case like this, when the physician only mentions the drug, without specifying the kind, we must use our own judgment. There are a number of official preparations of aloes in the 'Pharmacopœia,' and in all the purified Socotrine aloes is used; we, therefore, must use this same kind, unless otherwise directed."

The Junior then weighed the required quantity of purified aloes and that of asafetida,—both in powdered form,—and put them into a mortar. He then took the bottle containing the excipient powder, and took as much of the powder as would lie on the end of a spatula, when the Proprietor interfered.

"In studying pharmacy," he said, "one of the cardinal points is to be exact; and each action or deed, however small, must be done in such a way as to be a lesson for future instruction. In taking the excipient, you should, therefore, as a beginner, weigh the quantity, and not depend on such indefinite directions as, 'a little,' or, 'as much as will lie on a penny,' or the like. Suppose the pills should turn out to be a failure, and you come to the conclusion that you have taken too much of the excipient or too little, how could you increase or decrease the quantity, not knowing how much you took at first?"

"How much shall I take?" asked the Junior, impatiently.

"Take none at all," replied the Proprietor. "Pills containing gums or resins are best prepared with powdered soap as an excipient; and our constant guide—the 'United States Pharmacopœia'—will tell us how much to take."

He opened the "Pharmacopœia," which was always at hand behind the prescription-counter, and pointed to the formula for the official aloes and asafetida pills.

"But the proportion is different from that in our prescription," remarked the Junior.

"Certainly. If the doctor had wished to order the official pills, he would have written so; but the official formula will teach us the necessary proportion of the excipient to the drugs. You see that there is half as much soap as there are aloes and asafetida together; how much, therefore, should we take?"

"One-half of three and a half grammes, or one and three-quarter grammes."

"Express it in the metric system."

"One gramme and seventy-five centigrammes," said the Junior, weighing the soap.

"It is advisable," said the Proprietor, "to write the kind and amount of the excipient used on the prescription, so that, in case of renewal, the same will again be used, although to the thinking pharmacist there should exist no doubt what to do."

The Junior quickly mixed the three ingredients, and then dropped a rather large quantity of water into the mixture from a medicine-dropper, which was used in making pills and always lay on the prescription-counter.

"How many drops did you take?" asked the Proprietor.

"I do not know," answered the Junior, in confusion, discovering by the question that he had disregarded the advice just given. "But," he added, as an excuse, "I thought all that was necessary was to add sufficient water to make a mass."

"Yes, sir," said the Proprietor; "but it would be good for you to know how much this sufficiency is. Now go on with the work."

The Junior took the pestle and triturated the mass in a lively manner. At first the water seemed to disappear under the dry dust of the powder, but gradually the mass assumed a plastic appearance, and then, after a few more strokes, a very soft, almost semiliquid paste resulted.

"Oh, pshaw!" exclaimed the Junior, ceasing his work in disappointment; "there is too much water in it. I must now add some absorbent powder, liquorice or marshmallow."

"And by adding in that way," said the Proprietor, "you will make the pills as large as marbles. The addition of an absorbent powder is allowable only when the original ingredients are too soft to form a mass,—for instance, when pills are ordered consisting of extract of belladonna or of hyoscyamus,—but not to cover up a mistake in manipulation."

"But what shall I do about it?" asked the Junior.

"Throw the paste away, clean the mortar, and commence over again, following all the directions I gave you. I might have prevented you from adding the water, but since the ingredients of this prescription are not very valuable and time is not pressing, I thought I would give you a lesson according to the principle that a burnt child shuns the fire. I hope you will never forget that the greatest care is necessary in adding water to a pill-mass in which soap is the excipient."

During the conversation with the Junior the Proprietor had occasionally cast a glance at the box of capsules which the Senior had prepared; and while the Junior washed the mortar, he called the former, with the words: "Let us look again at your capsules."

The Senior took the box and opened it; but he had hardly looked at the contents when he exclaimed:

"Well, I declare! Did you ever!"

The mass had evidently expanded and forced the two parts of the capsules apart, so that some of the covers were entirely pushed off. On closer examination it was discovered that wherever the mass had protruded it had a porous appearance and seemed to be swelling further.

"I never saw anything like it in my life," exclaimed the Senior; "they were all right when I put them in!"

"After you have allowed your astonishment and disgust full scope," said the Preceptor, "let us come back to rational thought and discover the cause of the peculiar behavior of the capsules. What is the first thing that every observer would notice?"

"The enlargement and porosity of the pill-mass," said the Senior. "When I put it into the capsules it was not like that, although I thought towards the end of the work that I noticed a certain elasticity in it."

"What brought this change about?"

"That's what I don't know."

"Was there any force acting on the capsules from without?"

"No, certainly not," said the Senior. And, after a short pause, he continued: "A gas must have formed within the mass, and, in trying to escape, forced the capsules apart."

"Now you are on the right track," said the Proprietor. "Let us analyze the prescription and see what kind of a gas it may have been."

The prescription read:

Quininæ Sulph., gr. xl;
Pulv. Doveri, gr. xx;
Ammon. Carbon., gr. xxx.
Ft. caps. No. x.

"We have, first, quinine sulphate," the Proprietor continued,—"a combination of the alkaloid with sulphuric acid. Can any gas come from that?"

"I think not," said the Senior, "and I believe that I now understand the cause. Carbonic acid gas was evolved from the ammonium carbonate by the action of the sulphuric acid."

"Exactly; and what was the result?"

"Ammonium sulphate and quinine alkaloid."

"Yes, sir. Some of the ammonium carbonate was decomposed, and the evolution of the carbonic acid gas caused the mass to expand; while, at the same time, a little water of crystallization, set free from the quinine sulphate, softened it."

After a while the Senior asked: "Would it be right, then, to set aside the mass, after preparing it, until the reaction is completed?"

"That would be wrong," said the Proprietor; "for then we would not be dispensing what was prescribed."

"Then I must take the prescription to the doctor," said the Senior, "and call his attention to the incompatibility of the chemicals."

"Not at all," was the answer; "we will do no such thing. It is true, quinine sulphate and ammonium carbonate are commonly called incompatibles; but they are not so as long as they are kept perfectly dry. We must, therefore, mix the drugs thoroughly, divide the powder into ten equal parts, and put these into so many capsules without first making a mass."

"Well, I suppose I may start over again," said the Senior, with surly voice. "If it were my prescription, I would simply remove some of the mass and close the capsules again."

The Proprietor thereupon put his hand on the clerk's arm, and, with a distinctive frown, said: "The only excuse for this utterance is your youth and the dissatisfaction with yourself, so natural after a failure like this; but never express such an idea again. You not only show your unfitness for the pharmaceutical profession, but also utter an opinion the execution of which is criminal."

"I did not mean to do any wrong," meekly said the young man. And the Proprietor answered:

"I know; but let me make clear to you what you advocated. In the first place, the physician would be deceived, for you would dispense less and different medicine than he ordered. If his diagnosis was correct, —and we have no reason to assume that it was not,— he will soon discover where the fault lies, and his prescriptions will not come here any more. Secondly, you would wrong the patient, undermine his confidence in his physician, retard his convalescence, or even become morally responsible for his death if it should be hastened in consequence of your action. Thirdly, you deceive yourself; while you imagine you are following an honorable profession, your carelessness becomes a criminal habit, and in business you will surely be a failure, if no worse and sadder consequences befall you. Substitution for gain is bad enough; but substitution out of mere laziness, or to hide ignorance or a mistake in manipulation, is ten times worse. Always be right and do right, and shun no trouble to build up your reputation as an honorable, conscientious pharmacist."

CHAPTER XVIII.

DISPENSING IN CAPSULES—CAPSULE-FILLER—SOURCE OF ALOES AND ASAFETIDA — PROPERTIES OF PLANTS.

THE Senior, feeling the justice of his preceptor's moralizing remarks, made no reply, but quietly again weighed the ingredients of the troublesome prescription, and, after mixing them thoroughly, put the powder on a piece of paper, and, taking ten empty capsules No. 1, he proceeded to fill them by holding one after another in a horizontal position, and shoving the powder into it with a spatula.

"How many grains are you putting into each capsule?" asked the Proprietor.

"Well, I suppose I am wrong again," ejaculated the Senior, after a moment's reflection, throwing down capsule and spatula. "You mean to say that I should have weighed the quantity for each capsule. But this is the manner in which my former preceptor filled capsules, and, if some was left at the end, he threw it away."

"And if there was not enough of it?"

"There always was, for he selected capsules small enough to insure it."

"Learn, then, to do things right," said the Proprietor.

The Senior looked at the prescription again, and said:

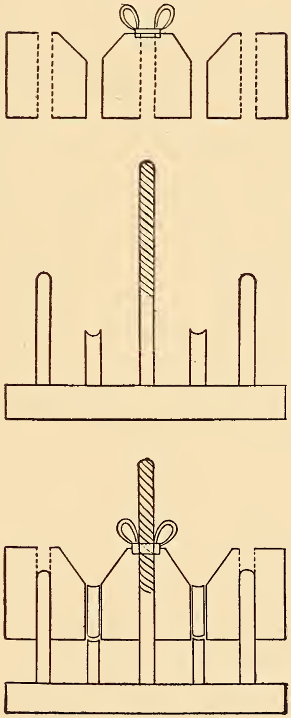
"There are ninety grains for the ten capsules, or nine for one capsule. It is easy enough to weigh nine grains, but not so easy to get them into the capsule."

"There are a number of contrivances for this purpose, as you can see in the works on pharmacy; but all of them are less practical than this capsule-filler that I have constructed myself. It consists, as you see, of three pieces.

"The first piece is a block of wood about one inch wide, five inches long, and a little over one inch thick. It has twelve perforations, which at the upper end are widened, like so many small funnels. The perforations correspond exactly to the capsules No. 1, so that the latter can be pushed into them. In the middle of the block, at the upper side, a round fly-screw is fastened under an overlapping flange in such a way that it can easily be turned, but not removed. Besides these twelve perforations, there are two larger holes, one at each end of the block.

"The second piece consists of a firm base, with two upright pins fitting in the larger holes of block No. 1. Then there are twelve smaller pins, concave at the tops, and fitting into the twelve perforations of piece No. 1 when this is put over it. In the middle there is a stationary iron rod, fastened to the base, and provided with a screw-thread to fit the nut of the fly-screw.

Fig. 4.



"The third part of the apparatus is the plunger, a small stick fitting into the capsule, and having one concave and one convex end.

"The *modus operandi* suggests itself. After putting the first two pieces together,—and they are always kept in this position, ready for use, the pins just entering the perforations,—the empty, coverless capsules are put into the holes, into which they fit very snugly, and, if necessary, the convex end of the plunger is used to press them down, the depth of the perforations being such as to allow the capsules to sink just below the funnel-shaped opening. The proper quantity of the medicine is now put into the little funnel, and worked down with the little stick or plunger."

The Preceptor accompanied the explanation by the action, and continued:

"The object of the concave end of the plunger is to leave a small convex elevation on the capsule, destined to fit into the rounded cover. After filling the capsules, we turn the nut of the fly-screw a little, thereby lowering the upper block, and consequently lifting the capsules up, as they cannot pass the pins on which they rest. After a few turns, when they are about half-way out of their envelopes, we put the covers on, and, by screwing a little more, throw them entirely out of the holes. With this little apparatus twelve capsules can be filled at a time, but we might just as well have more. The machine could also be improved by making it out of hard rubber, instead of wood."

"This is an excellent contrivance," said the Senior; "but I notice one drawback."

"And that is?" asked the Proprietor.

"We can use it for only one size of capsules."

"You are right, said his Preceptor; "but not the whole machine need be made over for another size. You will notice that the pins are much smaller than the perforations, so that they will fit into two other blocks, where the holes are made to correspond to capsules Nos. 2 and 3; but the same base can be used for all. Smaller capsules we are called upon to fill so seldom that I have not considered them; but where all sizes are ordered in considerable numbers, an apparatus for each size might be constructed without much expense. After filling capsules with such bitter material as our prescription calls for, the block should be detached, and the perforations cleaned by means of a small brush, such as is used for nursing-bottle tubes, in order to remove any small particles that may adhere to them. It is also advisable to wipe each finished capsule with a dry towel, and to put a little cotton in the box in which they are dispensed, to keep them from being crushed and thrown against each other, whereby the covers might drop off."

"Could we not moisten the end of the capsule before putting the cover on?" asked the Senior.

"In certain cases," replied the Proprietor; "but in this case all moisture should be carefully avoided, for reasons that I stated before."

He took a glass bottle from the shelf, containing a great number of filled capsules, and, shaking them, without being able to loosen the cover of a single capsule, said:

"These are five-grain quinine capsules, for which we have many calls. When we filled them we touched the interior of the covers (not the ends of the bodies of the capsules, as you suggested) with a moistened camel's-hair pencil, before putting them on, thereby gluing the two gelatin layers together and preventing the loosening of the covers.

"But what has become of your aloes and asafetida pills?" he continued, turning to the Junior, who had been a quiet listener to the explanations.

"I have the ingredients here," replied the Junior, "all well powdered and mixed; but I did not dare add any water, for fear of spoiling the prescription again."

"Take the dropper," said the Proprietor, "and carefully add six drops of water, and stir."

The Junior did as directed, and, after thoroughly triturating the mass, said: "This mass seems to be moist enough, but it is not very adhesive."

Hereto the Proprietor replied: "Whenever you make pills of asafetida or similar substances, a few drops of alcohol greatly increases the adhesiveness of the drug; let us try it here."

He carefully put three drops of alcohol into the mortar, and asked the Junior to again work the pestle, and in a few seconds a fine plastic mass was produced. In trying to roll it out he took a small pepper-cellar, filled it with lycopodium, and dusted the pill-tile, when the Proprietor interrupted.

"Remember," said he, pointing to the prescription, "pulvere cinnamomi convolvendæ."

"Oh," said the Junior, "I thought that related only to the finished pills."

"Why not use it now? The lycopodium would partly cover the pills, and afterwards prevent the cinnamon from adhering."

The Junior substituted cinnamon for lycopodium, rolled out the mass, divided it properly, shaped the pills, and finally rolled them under the pill-roller, using a little more cinnamon powder. The pills presented a neat, even appearance, and were uniformly covered with a brown coating of cinnamon.

"Before dispensing them," said the Proprietor, "let us stop a few minutes and see if we can trace the drugs contained in these little pills to their source, and perhaps learn a little by the review."

"Oh, I know," said the Junior: "aloes comes from Africa, asafetida from Asia."

"Correct," replied the Proprietor; "these are the simple facts, as you are expected to memorize them for your examination. But the thinking dispenser will combine with them broader thoughts of a different nature. Here we have aloes. It grows, as you know, along the eastern coast of Africa, from the Cape northward almost to Egypt, and seems to increase in medicinal value the farther north its source, the most inferior quality, Cape aloes, coming from Cape Colony, and the best, Socotrine aloes, deriving its name from the island of Socotra, opposite Cape Guardafui, at the entrance of the Gulf of Aden. The gatherers are as many as there are different tribes of aborigines and European settlers on the coast, from the crude Hottentot to the more cultivated Dutch Boer and semicivilized Arab. The plant belongs to the lily order, and consists of a thick, fleshy stem, from one to four feet high, with a crown of sagittate or lanceolate leaves, whose color varies from light- to dark-green, with sharp spikes at the edges. The shape of the leaves and the size and number of the spikes differ according to the different species of the plant, of which Aloe Perryi (formerly called Aloe Socotrina) is the only official variety."

"Does the whole plant yield the drug?" asked the Junior.

"No," replied the Proprietor; "the leaves are the part which yield the aloes. They are broken from the plant, incised at the lower, thicker end, and put into small holes in the ground that have previously been lined with the skins of sheep or other animals, turning the smooth side upward. The juice runs out of the cuts in the leaves, and, when a sufficient quantity has gathered, it is inspissated, or thickened by the aid of heat, the best product resulting when only the sun is employed as the evaporating agent. As a curious incident, I will add that a short while ago one of the examiners of a State Board of Pharmacy mentioned that when he examined a number of candidates in materia medica, and happened to strike aloes as the subject of examination, he could recognize the students of a certain college by the 'monkey-skin' in which they all insisted the aloes was gathered. Further inquiry disclosed the fact that at this occasion the professor cracked a time-honored, annual joke about monkeys and their skins, by which the mode of gathering aloes was remembered. Besides the African kinds, there is another aloes from the West Indies, where the plant is now cultivated, coming into the market under the name of Barbadoes aloes, and recognized by our 'Pharmacopœia.' While this latter and the Cape aloes reach us directly from the gathering-places, the Socotrine is chiefly handled by the Arabs, who either send it up the Red Sea, or convey it to India to the Parsee merchants and the British traders."

"In the Indian market the aloes meets the other ingredient of this prescription, asafetida. This is a bad-smelling substance, oozing as a milky, opaque, fetid juice from the root of Ferula Fetida. Have you any idea how the plant looks? From the root-stock, which is sometimes, in full-grown plants, six inches in diameter and more than a foot long, somewhat resembling a beet, grow numerous spreading tripartite leaves of a leathery appearance and light-green color. Out of their midst rises a stem of a luxuriant, herbaceous nature, sometimes as high as ten feet, carrying at the top a numerously branched compound umbel of yellow flowers, which betrays the natural order of the plant."

"Umbelliferæ," interposed the Junior.

"Yes, sir," continued the Proprietor. "As to the odor, while it is so offensive to us, we are told that the people of Bokhara use the small plant as a green vegetable, as we do lettuce, and relish it. We, however, can hardly imagine that such a disgusting plant should grow in the same country where the roses of Kashmir bloom,—the beautiful home of the lovely Lalla Rookh. But nature delights in such contrasts, as if to warn us against a too free and unrestrained indulgence in her beauty."

"Do the natives of Persia and Afghanistan gather the whole roots for the gum-resin that they contain?" asked the Junior.

"No, sir; the way they gather the drug is this: The root-stock, which always protrudes several inches out of the ground, is freed from small rootlets and leaves in the month of June, selecting the plants that have not yet borne flowers, and a slice of it is cut off. The wound is then covered loosely with leaves and twigs, to exclude the sunlight, which retards the process; and it is left this way for a few weeks, at which time a thick reddish or brownish gummy substance is found on the exposed part. This exudation, a hardened suppuration of a vegetable wound, is removed, put into leather bags, and taken to Herat, the commercial centre of Afghanistan. The Afghan merchant knows the 'art' of adulteration as well as his Eastern brethren, for it is stated, on good authority, that hardly any asafetida leaves that city in a pure state, a red clay being used as an adulterant, which the pharmacists of Europe and

America have to filter out when making the tincture. From Herat the asafetida goes to India, and is thence brought by the Parsee and British traders into the markets of the world."

"There is one thing that often gives me food for thought," interrupted the Senior, who, after finishing his capsules, had attentively listened to the conversation. "Here we have this drug with antispasmodic and expectorant properties, growing so many miles away from us. Why cannot the plants around us produce a similar, or identical, effect on the human system? They all contain so much carbon, so much nitrogen, hydrogen, oxygen, calcium, and so on; and yet they vary so vastly in their properties. I wonder why it is."

"They differ not only in their effects on the human system," replied the Proprietor. "You might mention points of difference much nearer home. Look at their growth, their shapes, their beauty, their fragrance! The rose of Kashmir grows in the same ground with the Ferula Fetida; they drink the same dew, feed on the same soil, and the same golden sun ripens their fruits. But while the one fills the air with fragrance and enchants the eye, the other, like an evil spirit, destroys our rapture, and calls a chilly halt to our enchantment. Thus the good and bad live close together, not only among the plants, but also among men; and this close proximity of contrasts directs the differing thoughts of the thinker.

"Now let us return to our pills. If your imagination is lively enough, what a vision they will call up before us. There stands the peaceful, but indolent, Hottentot from Africa, with the sheepskin over his shoulder, little able to compete commercially with his neighbor, the shrewd, energetic Boer of the Transvaal; then comes the lithe, dark-eyed Arab, joining hands with the quiet, thoughtful Parsee merchant of India, who forms a connecting link between the gatherers of the two drugs. At his other side we see the kind-hearted, hospitable, Persian peasant and his athletic neighbor, the cruel, intriguing Afghan. Behind them, in the second row, stands the British trader, the sailor, the carrier of the treasures of the East, the wholesale dealer of Europe and America; and last, but not least, the modest hard-working pharmacist. All these handled the drugs of these pills; and each of them, however remote from the other and different in civilization, forms a link of the chain that binds men and nations together, like members of one great family."

CHAPTER XIX.

OFFICIAL PILLS—EXCIPIENTS—CARBOLIC ACID PILLS —COATING OF PILLS—MASSES—READY-MADE PILLS AND TABLETS—CONFECTIONS—TROCHES.

"HAVING completed our journey into foreign lands," continued the Proprietor, "let us return to our work and see if we can learn something more about pills. Are there any official pills besides those of aloes and asafetida, of which we have already spoken, that contain aloes?"

"Yes, sir," replied the Senior; "there are a number of official pills in which aloes is an ingredient. First, the pills of aloes, 'Pilulæ Aloes;' then the pills of aloes and iron, 'Pilulæ Aloes et Ferri;' pills of aloes and mastic, 'Pilulæ Aloes et Mastiches;' and, finally, the pills of aloes and myrrh, 'Pilulæ Aloes et Myrrhæ.'"

"All these pills," said the Proprietor, "have the laxative properties of aloes, modified by the second ingredient, which either diminishes the irritating influence of the bitter African drug or adds another quality to it, like the iron in the case of iron and aloes pills, which are often used in amenorrhœa."

"Are not the 'Lady Webster dinner pills' composed of aloes?" asked the Junior.

"There are various formulas for these laxative pills, all of which resemble that of the official pills of aloes and mastic. Now tell me which is the best excipient for these pills?"

"According to your former instructions," replied the Junior, "we should use soap."

"Yes, sir; soap is not only the best excipient for all resinous substances, but it also increases their solubility, and serves, therefore, a double purpose. The iron and aloes pills, however, contain confection of roses and aromatic powders, and therefore need no further excipient, while those of aloes and mastic and of aloes and myrrh in addition contain, respectively, red rose and aromatic powder as corrigents of griping, which powders also suffice to form a good pill-mass with water."

"Are there any other official pills containing soap?" the Proprietor further asked.

The Senior, expecting this question, had already made a mental review of all official pills, and promptly answered: "Yes, sir: the pills of Asafetida, the pills of Opium, and those of Rhubarb."

"Do not forget," added the Proprietor, "that whenever you use soap as an excipient you must be very careful in adding water, lest the mass become soft; and a few drops of alcohol will often increase the plasticity in case of resinous ingredients.

"Do you know of any pills in which oil is used as an excipient?"

"Yes, sir," replied the Senior: "the compound antimony pills; also called 'Plummer's Pills.' They contain sulphurated antimony, murcurous chloride, and guaiac, which are made into a mass with castor oil."

"In case of heavy metallic substances," continued the Proprietor, "without adhesiveness, I recommend and use powdered tragacanth as an excipient; it has always given me the best results. The 1880 'Pharmacopœia' ordered mucilage of tragacanth also in this case, and I fail to see why the change has been made, unless it was to conform with the British formula."

"But why should we change our 'Pharmacopœia' for the sake of the British?" asked the Junior. "I should think if the English use castor oil in making their pills, that would be a good reason for us to use something else."

The Proprietor laughed, and replied: "You are right in so far that for the sake of conformity we should never imitate our neighbor. But it would be just as bad, if not worse, if, for the simple object of differing from him, we should refuse to acknowledge or accept whatever he possesses good and useful. To suppose that because a custom or usage is prevalent in another country we must avoid and ridicule it shows neither common sense nor intelligence, and would lead us to that condition of which the Chinese are a good type. Civilization and science are universal, and bind countries and nations together as friendship unites individuals; both sides are always willing to give and happy to receive, and it is hard to say whether a deed of friendship is more honorable to the donor or the receiver."

Turning to the Senior, he continued: "Do you know of any official pills in which a vegetable extract as one of the ingredients serves at the same time as excipient?"

"The Compound Cathartic pill," replied the Senior, "containing compound extract of colocynth, calomel, gamboge, and extract of jalap, of which constituents the extracts, with the addition of some water, hold the mass together."

"Vegetable extracts," said the Proprietor, "are probably the best excipients we have for pills made of dry powder."

"Why, then, are they not prescribed in the official formulas?" asked the Junior.

"For the simple reason that they possess certain medicinal virtues that may not harmonize with those of the other ingredients. We are therefore not to use them unless the physician so states on his prescription. In other instances their dark color is objectionable. Take quinine pills, for instance: we could not use even the most indifferent extract—that of liquorice of gentian—without having its presence betrayed by the color. Some physicians who have learned their profession in all its phases know the value of vegetable extracts as excipients, and add at the end of their prescriptions some such line as this: 'Extracti Gentianæ,

q. s.,' thereby not only facilitating the work of the pharmacist, but also increasing the tonic effect of their medicine by the gentian."

The Senior, thinking he had caught his Preceptor in a contradiction, quickly looked through the prescription-files and, pointing to a prescription recently prepared, exclaimed: "Did you not tell the Manager when he showed you this prescription to be careful with the extract, and did you not say that this was a very ill considered order?"

The prescription in question read:

Quiniæ Sulphatis, ʒi;
Ferri Sulph. exsicc., ʒss;
Strychninæ Sulph., gr. ss;
Ext. Hyoscyami, q. s. ft. pil. No. xxx.

The Proprietor smilingly answered:

"The reason why I criticised this prescription as ill considered was because such a powerful extract as that of henbane is ordered as an excipient without stating the quantity of it to be used. One of the main principles in selecting the excipient must be its inertness; for it can hardly be expected that two pharmacists, however skilful they may be, will use the same quantity. Extract of hyoscyamus is not a drug that can be taken indiscriminately with impunity, some people being very susceptible to its narcotic action. I directed five grains to be taken in the prescription in question, and you see that a note was added to it indicating this quantity; but we used considerable syrup in addition, to make a good mass of the quinine and iron. Careless pharmacists might just as well have used thirty grains, or even more, and if the prescription should go to different stores, different medicines might be prepared. But let us return to our official pills. Do you know of any in which an ethereal oil is incorporated in the pills?"

"Yes, sir," replied the Senior; "there are two: the vegetable cathartic pills, 'Pilulæ Catharticæ Vegetabiles,' and the compound rhubarb pills, 'Pilulæ Rhei Compositæ.' In both cases oil of peppermint is an ingredient."

"So it is," said the Proprietor; "and in either case there is but little trouble in incorporating it in the vegetable drugs of the formula, the compound extract of colocynth, in the one case, and the rhubarb and soap, in the other, quickly absorb and retain it. But greater difficulty arises when the quantity of oil or other volatile substance becomes larger and no other drugs are present to serve as excipients. Let me show you some examples."

Turning to the prescription-files, he soon found the following prescriptions:

Ol. Tiglii, gtt. iii.
Ft. pil. No. v.

Acidi Carbolici, gtt. x.
Ft. pil. No. vi.

Pointing to them, he said: "In each case nothing but the active principle is ordered, and it is left to the judgment of the dispenser to select the proper excipient. The first prescription presents little difficulty. Croton oil being a fixed oil, the crumb of bread offers a very convenient excipient, selecting such a quantity as to make the pills of the size of a three-grain quinine pill The bread absorbs the oil readily, and after some pressure with the pestle a plastic mass is formed. The second prescription is not so easy. Many and various excipients have been recommended; but the difficulty with all of them is that the carbolic acid will, after a while, appear on the surface of the pill, 'sweat out of it,' as it is termed. Impervious coatings applied to prevent this are objectionable, since they are insoluble in the juices of the stomach and intestines, in consequence of which the pills would pass through the system intact. The method that I employ—and which seems to be as good as any, especially when the number of pills is small, so that they are consumed quickly—is this: To each drop of carbolic acid (or creosote, if the latter is ordered) I take a grain of powdered soap, and add enough powdered liquorice-root to form a mass. Careful observation in each case and long experience and clear judgment are necessary to overcome difficulties of this kind, for it is impossible to discuss all the formulæ and combinations that a physician may select under general rules.

"We will now consider two official pills in the manufacture of which a chemical change takes place."

"I know," said the Senior; "they are both iron pills: the one of ferrous carbonate, the other of ferrous iodide."

"Take the ferruginous pills first," said the Proprietor, "and tell me what chemical change happens in their preparation."

The Senior replied: "Ferrous sulphate and potassium carbonate are made to act upon each other, and the result is ferrous carbonate and potassium sulphate. Sugar, tragacanth, and marshmallow are used as excipients."

"Yes, sir," said the Proprietor. "The 'Pharmacopœia' directs the ferrous sulphate, in clear crystals, to be triturated with the sugar to a uniform powder. My experience is that by such a trituration a damp powder results, and less glycerin and water is needed than the official formula calls for. You know that we often have occasion to prepare these pills with the addition of aloes."

"Here is the prescription," said the Senior. "I only made it yesterday." He pointed to the following:

Potass. Carbon.,
Ferri Sulph., āā ʒiiss;
Pulv. Aloes, gr. x.
M. et ft pil. No. lxxx.

"You notice a difference in this favorite prescription of one of our physicians, in the quantity of iron used, as compared with the official formula. Our prescription corresponds to the French preparation, 'Blaud's Ferruginous Pills,' in which equal quantities of iron sulphate and potassium are used. You also know that we never use any glycerin in making these pills, and yet have no trouble with the mass. The official name has not been very fortunately selected, having been changed from 'Pilulæ Ferri Compositæ' of the former 'Pharmacopœia.' This change is likely to give rise to confusion, since many physicians are in the habit of ordering 'Pilulæ Ferri Carbonatis,' meaning thereby pills of Vallet's mass. What other official iron pills does the 'Pharmacopœia' prescribe?"

"The pills of ferrous iodide; they are prepared from reduced iron and iodine made to combine in the presence of water, after which, liquorice, sugar, extract of liquorice, and acacia are employed as excipients, evaporating the excess of water."

"Does that end the process?"

"No; the pills are shaken with an ethereal solution of tolu, whereby, after the evaporation of the latter, they become coated with tolu."

"What is the object of this coating?"

"It protects the pills against the action of the air, which would otherwise oxidize the ferrous iodide. For this same purpose there is also an excess of reduced iron in them."

"Does not the tolu also protect the pills against the action of the gastric juice?"

"No, sir; tolu is soon dissolved by that fluid."

"Is there any other official pill coated with tolu?"

"Yes: the last of the official pills, 'Pilulæ Phosphori.'"

"What care is necessary in their preparation?"

The Senior replied: "Phosphorus, owing to its great affinity for oxygen, easily combines with it; but the object of the pills is to administer pure phosphorus, and we therefore dissolve it first in chloroform, beating this solution into a mass with acacia and althæa, and a mixture of glycerin and water. The chloroform evaporates during the operation, and the pills are afterwards coated with tolu in the same manner as the pills of iodide of iron."

"I wonder," said the Junior, "whether there is a pharmacy in which these pills are made and used."

The Proprietor answered: "Even if these identical pills are never ordered, their formula serves as a good guide in similar cases. We ourselves looked for the *modus operandi* of aloes and asafetida pills when we prepared our last prescription; and there are many similar instances. If you should have occasion to make Blaud's pills with some modifications, like aloes, strychnine, arsenous acid, etc., all of which drugs are occasionally ordered with them, the directions of the 'Pharmacopœia' will be indispensable. Or a case might happen where it is necessary to coat pills with tolu, and the formula for the phosphorus pills will be your guide, even if your pills contain no phosphorus."

"Very true," said the Senior; "yet I believe that the 'Pharmacopœia' contains many formulas, or even drugs, that are never used in certain localities, and might just as well have been omitted."

"They might," said the Proprietor, "if the 'Pharmacopœia' had been written for only one place. I can point out a number of articles that I have never used in my experience of thirty years; and the same is true in almost every other pharmacy, no matter how large it is. But the United States cover a large territory, and the desires and wants vary greatly. I dare say that there are railroads on which we will never travel in our lives and books that we will never read, but that is no reason why such railroads or books should have no right to exist. Do not forget that each of us, no matter how important he may appear, is only like one small grain of sand, millions of which will, nevertheless, form mountains. There are some other official preparations in our 'Pharmacopœia' greatly resembling pills, but introduced under the heading of 'Massa.'"

"I know," said the Senior; "there are three of them. First, Massa Copaibæ, a mixture of Copaiba and Magnesia, also called Solidified Copaiba; secondly, Massa Ferri Carbonatis, generally called Vallet's Mass, after a French pharmacist who introduced the formula and *modus operandi;* and thirdly, Massa Hydrargyri, commonly called Blue Mass."

"Why are these masses not directed to be divided into pills?" asked the Junior.

"Because they are often ordered in combination with other ingredients, and they then form not only an important active part of the final product, but also serve as an excellent vehicle for the other ingredients. When required, pills can quickly be made of them."

"Most pharmacists," replied the Junior, "keep only the ready-made pills, and crush as many of them as will conform to the prescribed quantity whenever they enter as parts in prescription. I think that method is just as good and much cleaner than weighing a lump of the mass."

"Let us see how that will work," said the Proprietor. "Here is our bottle of gelatin-coated five-grain Blue Pills, which we keep to satisfy the wishes of some of our physicians. Now, suppose that we want to weigh eight grains of the mass, what would you do?"

"Why, nothing is simpler," quickly replied the Junior; "I crush two pills in a mortar and weigh eight grains of the powder."

"Please do so."

The Junior did as told, and when the eight grains balanced the scale, he looked triumphantly at his Preceptor.

"So far so good," said the latter; "now weigh what is left."

The Junior did so, and his air of superiority soon gave way to one of doubt and disappointment. "I do not understand this," he said; "there are over five grains left."

"You forgot," said the Proprietor, "that the gelatin with which the pills are covered weighs something; and, besides, we do not know if the manufacturer did not make addition to the mass. To do this work correctly you should first have weighed the two pills, and calculated from that weight the number of grains that would correspond to the eight grains of pure mass. But it cannot be expected that any druggist who is lazy and indifferent, as you claim most of them are, would go to such trouble. This is another instance, so often demonstrated, that the tendency to substitute ready-made goods for preparations which should be made in the laboratory will necessarily lead to criminal carelessness and neglect, and not only give the conscientious physician an excuse or notion of self-dispensing, but establish a necessity to do so."

"But are their tablets and pills any more reliable than the ones that we buy?" asked the Senior.

"They certainly are not; nor do I claim that all such goods are unreliable in themselves. But if the physician is compelled to order in such quantities as the manufacturer may prepare for him, in order to have at least some kind of a guarantee of correctness, the necessity of the pharmacist as intermediate between him and the patient ceases to exist. Such nearsighted pharmacists are like foolish sailors who, for the sake of patching an old coat, cut up the sail of their craft and helplessly drift against the rocks."

"Are not some masses, like the Copaiba mass, sometimes ordered to be taken in bulk without dividing them into pills?" asked the Junior.

"You are thinking of similar, more palatable, but much weaker preparations, the Confections, by which name the 'Pharmacopœia' denotes preparations in the form of a soft solid of a saccharine nature, serving as a pleasant vehicle for one or more medicinal substances. Your friend here will give you the names of the two official confections."

"Yes, sir," said the Senior; "Confection of Rose and Confection of Senna only are now official."

"These preparations," continued the Proprietor, "were formerly more numerous, and were classified as preserves and electuaries. They are now mostly superseded by Troches or Trochisci, of which a long list of fifteen are official. Most of them are prepared with mucilage of tragacanth and sugar and various aromatics like vanilla, oil of sassafras, anise, wintergreen, lemon, and others that serve to disguise the sometimes disagreeable taste of the medicinal substance."

"Can we not make troches here in the laboratory?"

"Why, certainly we could," said the Proprietor; "but they are cut much neater by power-machines, invented for this purpose, and the limited demand here does not warrant the purchase of such a machine. I therefore prefer to buy them ready made."

The Junior cast a significant look at his older companion, as if to say: "Now he admits doing what he told us not to do." The Proprietor, however, read his thoughts, and smilingly continued:

"You think you have caught me in an inconsistency, but I hope to be forgiven. In advocating the cultivation of professional pharmacy, not only as a distinct part of our daily work, but as an imperative duty towards the public and the physicians, we must not go to the other extreme and reject those innovations and inventions that are a natural development of all arts and sciences. We would otherwise become old fogies, and lag behind the advancing army of civilization, like an old stage-coach sneaking behind an express-train. Our ideal must be high and noble; but if it make us forget the needs and wishes of our surroundings, we will become flighty and conceited. If, therefore, a part of our professional work is better performed by a new industry, it is foolish to fight against it; let us rather adapt ourselves to new conditions and turn such innovations to our advantage. But let us never do so out of laziness, nor sacrifice accuracy and ability, as you proposed to do. For this reason I buy troches and gelatin-coated pills, for the physician and public demand them; but I do not guarantee them, and sell them as they are, the products of another firm."

The conversation was here interrupted, as a number of customers had entered during the last words, and produced what in business parlance is called "a rush."

CHAPTER XX.

A RUSH—INFORMATION TO CUSTOMERS—ANSWERING QUESTIONS—QUICK AND QUIET WORK—LINIMENTS—BASE OF LINIMENTS—OLEATES.

On such occasions the clerks in this pharmacy did not run aimlessly from one part of the store to the other; but each one took his definite position according to his ability and age. The Junior went to the soda-water apparatus and refreshed the thirsty with cooling drinks; whereas the Senior took charge of the opposite counter, selling the numerous small articles that are daily bought for home use. The Manager was seldom seen; for it was his duty to attend to the prescriptions; and the Proprietor kept a watchful eye over the whole store, helping wherever he was most needed, and giving explanations and advice to customers.

Such information, imparted to customers, never took the form of *medical* advice; under no circumstances would he interfere with the physician; and every question of such a nature was promptly answered by the words, "You must consult your doctor." But hundreds of small questions are continually asked that may appear trivial and insignificant to the casual observer, but which are of great importance to the questioner; and a kind and plain answer in such cases is one of the best *advertisements* for a pharmacy. This customer wishes to know how "Senna and Salts" should be prepared for administration,—whether he shall take it hot or cold, before or after breakfast. The next one desires information on the proportion of Lime Water and Milk for her first-born. "The doctor told me, but I forgot." This crying baby on her mother's arm has spilled some hot coffee over her chubby hand; that excited woman brings her little boy, who has swallowed a penny; or her little girl, who has tasted some of her father's medicine. Others show printed prescriptions, cut from sensational daily papers, intended to make medical advice cheap, but generally confusing to the layman, and often misapplied. The question whether "one or two teaspoonfuls of tincture of aconite" should be taken, as an instance, shows to what danger such indiscriminate advice may lead, and that there is certainly more harm than good done by such papers.

But not all questions are put in *good faith;* many are asked to elicit a predesired answer, which is intended to be used as an excuse for some mistake or as a motive for some rash action. Who does not know the man who comes with the impertinent question: "Is such a doctor a good doctor?" and before a reply can be made he continues to tell the pharmacist a long tale of woe,—how the doctor treated his boy for pneumonia, when everybody knew he had malaria; how he gave him the wrong medicine and ordered him to eat little, when everybody could see that he was starving the poor fellow; and the final question is: "Don't you think I should call in another doctor?" He wants to hear the answer: "Yes, do so;" and will then tell the doctor that the druggist advised him to call another physician, because he (the first one) was treating his child wrongly. Thus the seed of discord between physician and pharmacist is often sown by a dissatisfied patient; and the same man who abuses the physician before the pharmacist will also abuse the pharmacist before the physician.

Another customer, equally annoying but less dangerous, is the man who *has made up his mind* that he wants a certain patent medicine, and tries to coax the answer from the phamacist that such an article is the best, in order to quote him as his authority. In such cases let the pharmacist beware; short, decisively negative or directly declining answers are the best, and courtesy becomes a weakness. Plentiful, also, are the instances when patience and self-control must be practised. Again and again that pitiable woman will appear who claims that the second bottle of medicine for her sick child is not the same as the first was,—it tastes different and it looks different, and her poor child cannot take it. "I am sure, doctor," she exclaims, "that some mistake was made. My God! my child is poisoned! What will I do if she dies!"

These unfounded exclamations are made in the highest pitch, in the presence of a dozen customers, who are at once attracted, by the gestures indicating the despair of this excited mother, whose nerves, in consequence of many wakeful nights and the worry over the life of her child, are strained so that she sees the dire spectre of death lurking in every corner. It is a difficult task to convince her that her child has been worn out by this incessant urging to take the bitter medicine or by senseless promises never kept; or, in the beginning, when the little patient was weak and powerless, she took to it without resistance; but now, at the first sign of convalescence, her sense of opposition returns, she objects to everything disagreeable, is allowed to eat candy, and the lingering sweetness on the tongue renders the medicine more distasteful.

While this nervous mother is still clamoring, the customer who is always in a hurry rushes in, pushes his way through the store, and addresses the Proprietor in a commanding tone: "Hurry up; here is a prescription! Put it up at once; it is of the greatest importance!" And the directions probably read: "To be taken at night!" Meanwhile, a jolly company of young people have taken possession of the soda-water counter, and, after listening to some jokes, burst out in boisterous laughter, forming a discordant contrast to the weeping mother and heightening if possible her nervous excitement.

In such moments the pharmacist may be likened to the captain whose small craft has suddenly been seized, he does not know how, by rushing rapids; for a moment he thinks he cannot resist the confusion around him and that all is lost, but his sense of duty, his consciousness that he can find a way out of the danger, give him strength and self-reliance. Patience, self-control, and presence of mind are his allies that help him through the eddies.

A great help in meeting the extra demands of a "rush" in this store was the ease and quickness with which every customer could be waited on. The Proprietor considered despatch and promptness among the main requirements of a skilled pharmacist; and everything in the pharmacy was arranged for this purpose. Bottles and jars on the shelves were in strict alphabetical order,—the liquids apart from the solids; the drawers and closets behind and under the counter were always well filled, and each article, of whatever size or quality, had its fixed place, and was always found in that place. After waiting on one customer, bottles, boxes, or packages were returned to their allotted places before the next customer was approached, unless they had been brought in from the cellar or laboratory, in which case they were temporarily placed on a table in the rear until after the "rush." "Hunting" for an article was consequently unknown, and the Proprietor used to say that a good pharmacist must be able to find every bottle, drawer, and article in the dark.

In order to further expedite business, all goods in daily demand were kept put up in such quantities as were generally demanded, properly labelled, and arranged in a number of drawers and closets behind the counter. The dull hours in the afternoon were mostly employed for such work of preparation, and an idle moment was an unknown quantity in this pharmacy. "A pharmacist," said the owner, "who has not *some* work for every minute of the whole day—whether there be customers or none—does not understand his business. We are never 'done;' our profession is a progressive one, and the chances for improving something never cease."

While the whole force of the pharmacy were thus waiting on their patrons, a customer, evidently a laborer, suddenly pushed his way through the crowd, and, holding up a prescription, exclaimed, in great excitement: "Give me this at once! My boy fell against a red-hot stove. Hurry up, or he will die!"

The Proprietor took the prescription, excused himself in a few words to the customer with whom he was talking, went to the small desk near the prescription-counter and at once wrote the directions. He then took a filled pint bottle out of a closet, substituted the written label with the directions for the label on it, and wrapped it in paper. All this was done in a quick but quiet way, without the least sign of haste, rubbing or pushing against no one, yet making no unnecessary or useless motion. In less than two minutes the bottle was handed to the customer.

"Put the bottle in warm water," he said, "if the liniment should thicken before you reach your home."

The customer thanked him profusely and rushed out.

"Is it anything serious?" asked the lady on whom the Proprietor had waited last.

"It is hard to say," replied the Proprietor. "A child was burned, the doctor ordered a liniment, the father is excited over the suffering of his boy, and I consider it my duty in such cases to postpone every other business and speedily prepare the prescription. I trust you were not offended by this delay."

"Not at all," replied the customer; "I rather felt pleased at the way in which you treated the poor man. I remember that I once entered a pharmacy where the Proprietor was talking with a friend, evidently a travelling salesman. He paid no attention to me at all; but, as I was not in any particular hurry, I did not mind it. After a while a little girl came in and handed him a prescription. Instead of preparing it at once, he continued to laugh and chat, and when the child timidly approached him with the words, 'Please, sir, ma is very sick; wouldn't you give me the medicine?' he gruffly turned to her, saying, 'Sit down and wait until it is done.' He then continued his unimportant conversation for several minutes. I felt highly provoked, and resolved never to trust that man with a prescription."

After the rush was over and every bottle and package had been returned to its allotted place, the Senior, who was in a criticising mood, pointed to the prescription that the Proprietor had prepared so quickly, and said:

"I guess that you overlooked that the doctor ordered only twelve ounces of liniment, when you dispensed a pint."

"I was fully aware of it," replied the Proprietor.

"But have you not often told us that we should never alter a prescription?"

"So I have; nor did I alter anything in this case. Let us look at the facts. The prescription calls for Linimentum Terebinthinæ, or Turpentine Liniment. There is only a limited demand for this preparation, but whenever it is wanted, it is wanted quickly, as an application to burns and scalds. Being a mixture of resin cerate and oil of turpentine, it cannot be prepared extemporaneously without the loss of some very valuable time; and on account of its tendency to solidify in a moderately cool atmosphere, it is even impossible to pour it from one bottle into another without warming it first. We therefore keep it in eight- and sixteen-ounce bottles, ready to be dispensed without the least delay. The increase of the quantity from twelve to sixteen ounces was done for no other motive than to relieve the suffering of the patient and the anxiety of the father as quickly as possible, and no harm can be done by such action. If, however, the order had been for some medicine for internal use, we would not be allowed to increase or decrease the quantity, because often the physician wishes a certain number of doses to be taken, and writes his prescription accordingly.

"Let us take advantage of this opportunity and shortly discuss the various official liniments. Beginning with the Turpentine Liniment, of which we have just spoken, it leads us to those liniments that contain a fatty or oily substance in their bases; which are they?"

"I think I can tell you," said the Senior. "There is, first, Ammonium Liniment, or Volatile Liniment; secondly, Lime Liniment, Linimentum Calcis, commonly called Carron Oil, after the Carron Iron-Works in Scotland, where it was the standard remedy for burns; and Camphor Liniment, or Camphorated Oil. These three have cotton-seed oil as a base."

"There is another liniment with a fixed oil," said the Proprietor, "although it serves only to give consistence." When no one answered, he continued: "I refer to Compound Mustard Liniment, Linimentum Sinapis, consisting of volatile oil of mustard, fluid extract of mezereum, camphor, and alcohol, to which fifteen per cent. of castor oil is added. This oil was probably selected on account of its miscibility with alcohol. Mustard Liniment, therefore, forms a connecting link between the oily and the alcoholic liniments."

"I know the latter," said the Senior, anticipating the question; "they are Linimentum Saponis Mollis, formerly called tincture of soap; Linimentum Saponis, the ordinary Soap Liniment, sometimes called Liquid Opodeldoc; and Chloroform Liniment, being a solution of thirty per cent. of Chloroform in soap liniment."

"You omitted one liniment made from a fluid extract," said the Proprietor, "namely, Linimentum Belladonnæ, being a solution of camphor in the fluid extract of the root."

"Should not the oleates be classified among the liniments?" asked the Senior.

"The oleates," replied the Proprietor, "are a separate class of pharmaceutical preparations, consisting of a compound of oleic acid with alkaloids or the oxides of metals, generally dissolved in a great excess of the acid. As far as their medicinal properties are concerned, they correspond to ointments, and are preferred by many practitioners on account of their greater cleanliness and elegance. There are a great number of oleates in the market, but only three—those of Mercury, Zinc, and Veratrine—are official. They are supposed to be thick liquids, but they often solidify on account of the presence of palmitic and stearic acids in the oleic acid. But do not forget your duty," he added, turning to the Junior, who had stopped in his work to listen to the conversation, holding a number of cards of the size of a small letter-sheet in his hand.

CHAPTER XXI.

PRESCRIPTION-FILES—RECORD OF BUSINESS—CONFIDENCE—DOCTORS AND CUSTOMERS.

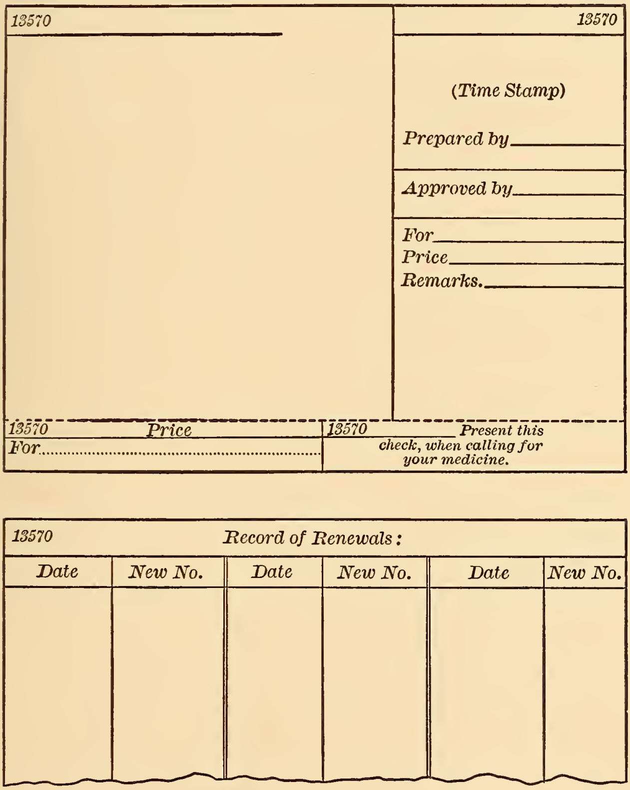
The cards that the Junior was about to arrange were part of the prescription-files, which differed considerably from those found in most pharmacies. Each prescription, when received, was at once pasted on a card, eight by ten inches in size, ruled in the manner shown on page 283.

The large space to the left was intended for the prescription. Should the latter be too large for the space, it was folded over and then pasted to the card. When the customer wished to retain the prescription, it was copied on the card by one clerk, stamped with a rubber stamp, reading:

Prescription No..
Copied from original....................................
by...
Checked by..
Date...

and the various blank lines filled in by two different pharmacists, as indicated. Every prescription-card was provided with a running number, appearing at the head of the card and twice again at the bottom on two small slips which could easily be removed from the main card on account of the perforated lines. The slip to the right was handed to the customer as a check for his

Fig. 5.


13570

13570

(Time Stamp)

Prepared by

Approved by

For

Price

Remarks.

13570 *Price*

For

13570 *Present this check, when calling for your medicine.*

13570	*Record of Renewals:*				
Date	*New No.*	*Date*	*New No.*	*Date*	*New No.*

prescription, to be returned when the latter was delivered, either in the pharmacy or at the customer's residence by a messenger; the other slip was attached to the finished prescription, after having been wrapped, and served as an identification. The blank space under the running number of the main card was filled by a time-stamp, giving the year, day, hour, and minute when the prescription was presented. Under the stamp the two dispensers would write their names, first, the one who prepared, and then the one who checked the prescription. The next entries were the price and the customer's name. Finally, a space was left for remarks, in case some special difficulty presented itself. Here, also, the kind and quantity of excipient for pills or capsules was entered, the number of the capsule used, and other particulars worthy of being remembered. Finally, a second time-stamp was put on the card, showing the minute when the prescription was finished and ready to be delivered. In case of a renewal, the large blank space received the entry: Renewal of No. —; and a corresponding entry was made on the back of the original card, which was ruled for this purpose. For instance, the original would be No. 3125, and the renewal 4376. The entry on 4376 would be, Renewal of 3125, all other entries to the left being the same as before. Card 3125, which had to be taken out of the cabinet, would receive the entry on the back: Renewed February 12, '97, No. 4376. In this way a full record of the whole history of each prescription was kept, and a mistake rendered almost impossible. The cards were arranged in drawers of corresponding size, eight inches high and ten inches wide and almost two feet deep, each drawer holding two thousand cards. Index cards, put at distances of each fifty, facilitated the finding of any one particular prescription. As the prescriptions in this pharmacy had passed the number two hundred thousand, there were more than one hundred drawers filled with such prescriptions, all neatly and orderly arranged in a large cabinet,—or, rather, a number of cabinets, as new sections had been added from time to time, as necessity required.

The work in which the Junior had been interrupted consisted in returning a number of cards that had been used for renewals to their allotted places, and also putting new cards into the last drawer.

"In my former position," he said, giving his voice a slight tinge of blame, "not so much fuss was made with the prescriptions; they were simply strung on a long wire."

"You mean," said the Proprietor, "they were kept carelessly and considered of little importance."

"Well yes, if you choose to put it so," was the reply; "but then there were not so many."

"Perhaps the carelessness with which the prescriptions were treated accounted for the small number," said the Proprietor.

"Well, that may be; but allow me to make another remark, without wishing to criticise your actions. I sometimes think that a great deal of fuss and unnecessary ado are made here about small matters.

Why is it necessary to keep these records, some of which are thirty years old, with such exquisite care? Their contents are forgotten and useless, and the prescriptions contained in them are never renewed. The sick children of thirty years ago are now grown persons, and the adult people who needed medicine then are probably all dead. And yet the prescriptions are kept with the greatest care—almost with reverence; dusted every morning, and each little defect that age or long wear may have produced is carefully repaired or concealed. I will not say that they should be thrown out, but they would do just as much good in a dark corner of the cellar."

"You talk like a boy," answered the Proprietor, in a quiet but earnest way; "and your frank but unripe criticism of my actions betrays your youth and lack of experience. But I will overlook the stinging offence that words like yours in emanating from other lips would give me, and in your own interest tell you something about these cases, with their rows of silent preachers, whose teachings and warnings are comprehensible only to those who have a higher conception of their profession than the ordinary pharmacist, and consider pharmacy their beloved friend.

"In the first place, those cards are a good record—perhaps the best—of the growth of our business. Look at the first day, three prescriptions; the second, three; the fourth, four; and so on. These figures recall to me the days when I made the first venture in business myself. In an instant I live again through the hopes and fears that filled my heart thirty years ago. I recall the joy that this first prescription awakened in my mind. I read it over and over, as I did then; I feel again the responsibility of my profession, as I did then. Do you know that when I compounded this mixture thirty years ago I became aware for the first time that I not only mixed some tinctures and dissolved some salts, but that I was laying the first foundation-stone of my reputation; that to erect a strong and beautiful building each stone should be examined, for as a powerful structure is only as strong as its weakest part, so a reputation for ability and efficiency will never cover the blame of one mistake. It was then that I resolved that the love and care with which this first prescription was treated should never leave me; that should I be destined ever to own or control a larger business than the small store in which I commenced, each prescription, yea, each bottle, each box or drawer, should be treated with equal feeling, as a friend would treat his friend. Do not think that the rise of my business—from the small beginning, when I considered the daily sales, amounting to but a few dollars, an ample reward for my labor and effort, to the present comfortable state—has taken place without worry and trouble; but, believe me, that often—when I felt like despairing of success, when I saw how my good intentions were being misunderstood, how my ideal was being scorned and laughed at—did I take down and look at these first prescriptions and renew the vow. You may say that such a sentimentality betrays a soft heart, unfit to grapple with the stern reality of business life. To some extent you may be right; but I claim that the pharmacist who has neither heart nor soul—only brains—may turn out to be a successful merchant, but he will never be an ideal pharmacist. However, I will speak of this some other time.

"Now take the second drawer, started almost two years later. The number of prescriptions of each day has increased to ten or twelve. This shows an advance. The time had come when the question of an assistant arose. Till then I had done everything myself,—sweeping, cleaning, dusting, washing windows, laboratory work (what little there was), and assaying, being at the post of duty morning and evening, day and night. Now the first assistant came, and with him new hope and prospects, but also new care and worry. Then look farther on, and you will see a slow but progressive increase."

"Well," interrupted the Junior, "no wonder; the city has grown in population and, consequently, in business."

"But the number of stores has also increased," replied the Proprietor; "three of my former assistants have settled in my neighborhood, and other men have come from outside, so that the number of inhabitants to each pharmacy is not greater now than it was thirty years ago. But the financial result is the least that the prescription-file might show; it is rather the increased confidence of the physicians and the public in our pharmacy that forms the pleasing element in the larger prescription trade. There are many families here now whose parents were sent here when they were children, and who will not deal anywhere else. But there are many other features about these cards that are worth knowing.

"Look again over the prescriptions from the beginning. How the doctors have changed! Here, thirty years ago, the doctor from whom I received my first prescription was a man in the height of reputation; his income was large, and his practice probably the best in the city. Watch his writing as I turn the cards. The firm lines gradually become indistinct and illegible; eventually it is really impossible to decipher his scribbling, and only our knowledge of his customary orders enabled us finally to fill them. Here is his last one, a mystery to every one here but myself. He died an ignoble death, a victim of alcohol. Now take this man's prescriptions. You know he is considered one of our best physicians, and there are many families here of high intelligence who would rather die than call another man to their bedsides; and yet we know from his prescriptions that all his resources are about twelve drugs, and about as many prescriptions, written with many grammatical errors, one of which prescriptions he makes to fit each case."

"Perhaps the smallness of his stock is the secret of his success," said the Senior, ironically.

"His life and success show how pleasant manners and the art of discretion are a power that will sometimes outwit science and knowledge. Then take this man. His prescriptions show the earnest and conscientious student; in his endeavors to do the best for his patients he will sit up a whole night, worrying and studying over a case, and hunt through all the literature he can find on the disease in question, and his prescriptions are a true mirror of his interest in his patients. You know how often he will stop here and discuss with us the properties of new drugs, or the result of any great scientist's investigation."

"It never struck me that there was so much to discover in these prescription-files," said the Junior.

"Nor is this all," continued the Proprietor. "We have traced our own record and that of our physicians. Now let us see if these pages do not tell us something also about our customers. I will not speak of all the friends and neighbors who have passed away during the last thirty years, and whose last potion I prepared. To you they would be nothing but names. But as I look over these cards, I see more than simple orders for medicine. Between the lines appear the faces of old and young friends, men and women whom I knew, who once stood in this pharmacy, and who were as dear to me as I was to them. This sheet recalls to me the bright, lovely face of a promising young woman, living in luxury, who was the pride and hope of her parents. I still hear her consumptive cough, as I heard it when I saw her last; and the echo comes back from the next prescription, a similar one, ordered for a poor young man who, in the struggle to provide for his sickly parents and large family, contracted the same disease. Thus we are reminded that sickness and death are the greatest levellers of all earthly distinction and privilege, sparing neither youth, beauty, nor wealth."

"A rather sad contemplation," said the Senior, "to think that we should make a living out of the misery of others."

"It would be so," said the Proprietor, "if it were the only thought that we could find in our profession. But consider also that the health, often the lives, of such patients rest in our hands; that the little scale on which we weigh the potent drug may, according as we are accurate or careless, determine whether the patient shall suffer or be relieved; consider that by a faithful and conscientious performance of our duty we send a ray of hope, a lease for a new life, into the sick-room; and then tell me if there is not also a bright side in such a contemplation!"

"Why, certainly there is," replied the young man; "and it teaches us to be careful and accurate."

"That is the right way to close such a reflection," said the Proprietor; "it teaches us accuracy and fills us with love and devotion for our profession."

CHAPTER XXII.

SALVES—SKILFUL MANIPULATION—CERATES—OINTMENTS—DIFFICULT OINTMENT PRESCRIPTIONS—OINTMENT FILLER—BENZOINATED LARD.

"If there is any particular part of our work that I like less than the other, it is the making of salves and ointments." With these words, the Senior checked off a number of drugs that he had weighed out and put in a row before him,—namely, three hundred and fifty grammes of rosin, one hundred and fifty of yellow wax, and five hundred of lard, which ingredients form Ceratum Resinæ, commonly called Basilicon Ointment.

"What is there disagreeable about their preparation?" asked the Proprietor.

"Almost everything, from beginning to end," was the reply. "The weighing of wax, lard, and oils, the great chances of soiling your clothes, the unpleasant feeling of fat on the hands, the pungent odor of the boiling fat, the difficulty of cleaning the various implements afterwards,—I do not think there is anything more disagreeable than all this."

"Your lack of practical experience in this line of preparations," replied the Proprietor, "makes you dislike your work. Beginners are apt to charge errors in manipulation to the preparations, and instead of looking to themselves for improvement, abuse the innocent object of their lack of skill. Proceed."

The Senior put the other ingredients into a large, flat, porcelain-lined iron dish, put the latter on the gas-stove, and lighted the gas at full blast.

"Now read the directions of the 'Pharmacopœia,'" said the Proprietor, turning off the gas.

"Melt them at a moderate heat——"

"Moderate! Was that a moderate heat? The large flame that you lighted is apt to melt the lard and bring it to a boiling-point before the rosin is liquefied, and this lack of judgment on your part produces one of the objectionable features, the pungent odor. Now try the operation with a sand-bath."

The Senior did so, and the lard, wax, and rosin were soon liquefied without emitting any perceptible odor.

"Rosin is never free from impurities," said the Proprietor, "and it is therefore necessary to strain the mixture through muslin." He then spread a piece of muslin over a jar and gently pressed the middle of it down to the bottom of the jar, after which the liquefied cerate was slowly poured into it. Taking the four ends of the muslin together, he lifted it out of the jar, so slowly, however, that the salve had time to pass through it. The muslin he then put into the iron dish. "You see there is but one dish to clean," he said to the Senior, "and neither my hands nor my clothes have been stained. To avoid separation you must stir the cerate until cool. Take this glass rod." While the Senior stirred the ointment, the Proprietor continued:

"Do you know how many cerates are official?"

"Yes, I know; there are six besides the one that we are making. They are Simple Cerate, Ceratum, a mixture of white wax and lard; then Ceratum Camphoræ, made with camphor liniment; Ceratum Cetacei, or sperm cerate; Ceratum Cantharadis, made of Spanish flies, yellow wax, resin, lard, and oil of turpentine; and, finally, Ceratum Plumbi Subacetatis, or Goulard's Cerate, being a mixture of solution of lead and subacetate and camphor cerate. It should be freshly prepared when wanted."

"What is the difference between cerates and ointments?" asked the Proprietor.

"Cerates," said the Senior, "are named after one of the principal ingredients, 'cera,' wax, and are of such a consistence that they may be spread upon cloth, while the ointments are softer, and are applied directly to the skin by inunction. Nearly all of the ointments contain lard, either plain or benzoinated, and a number of them are simply a mechanical mixture of this vehicle, with some medicament, like powdered Gall, Tannic Acid, Carbolic Acid, Extract of Belladonna, Extract of Stramonium, Iodoform, Sulphur, Veratrine, Zinc Oxide, and others. A few are made by fusion, like Unguentum Aquæ Rosæ, or Cold Cream, Unguentum Diachylon, and Unguentum Picis Liquidæ, or Tar Ointment."

"Which metal enters into the greatest number of ointments?" asked the Proprietor.

"Mercury," was the reply; "we have the Unguentum Hydrargyri, or Blue Ointment, and that of Ammoniated Mercury, Nitrate of Mercury, and the red and yellow Oxides of Mercury."

Meanwhile, the Resin Cerate had sufficiently cooled to allow the glass rod to be withdrawn, and the Proprietor invited the Senior into the pharmacy, where he showed him a prescription. It read:

Extr. Stramonii, ʒii;
Ac. Tannici, ʒi;
Pulv. Opii, ʒss;
Acidi Carbolici, gtt x;
Unguenti, q. s. ad ℥ii.
Fiat unguentum.

"How would you prepare it?"

"I would mix the first four ingredients and then incorporate them with the ointment."

"If we had more time," replied his Preceptor, "I would let you try it, and you would discover that an unwieldy, sticky mass, resembling a soft resin, would be the result, not adapted to be mixed with the ointment. To prevent the different ingredients from reacting on each other, each one should be incorporated separately with a small quantity of ointment, and, finally, the various parts be mixed."

He proceeded to weigh the Stramonium Extract, Tannic Acid, Powdered Opium, and ointment, the quantity of which was first calculated, putting each article before him on a large pill-tile, together with a small bottle of Carbolic Acid.

"Now prepare this salve," he said to his assistant, "beginning with the Carbolic Acid, which on account of the prescribed ten drops, I did not weigh."

The Senior quickly seized an iron spatula, and, cutting off a part of the ointment, flattened it on the slab and dropped ten drops of the Carbolic Acid on it. This was dexterously done by holding the small bottle in the hollow of the hand with the thumb and the two last fingers and putting the digit and middle fingers around the glass stopper; then bringing the bottle into a horizontal position, the stopper was carefully loosened, thereby having perfect control over the liquid so that the required number of drops could easily be counted.

"That was well done," said the Proprietor; "but put aside the iron spatula. The carbolic acid, and, more still, the tannic acid would react with the iron and blacken the spatula. For this and similar preparations we have the horn spatula."

The Senior changed his spatula as directed and thorroughly incorporated the carbolic acid with some of the ointment, leaving the completed mixture at one side. The next step was to scrape the extract of stramonium off the small piece of paper on which it was weighed;

but before his intention to take more ointment was executed the Proprietor again stopped him.

"You notice," he said, "that this extract is rather hard, and you could never make a homogeneous mixture of it in this way with ointment. Remember your 'Pharmacopœia,' and do not forget that in many instances the directions given for an official preparation may serve us as a guide in similar cases. The directions for the official ointment of Stramonium begin with the words, 'Rub the extract with the diluted alcohol until it is uniformly soft.' The quantity of diluted alcohol is half that of the extract; let us therefore adopt the same method."

"According to that we need one drachm of diluted alcohol for our prescription," said the Senior, measuring the liquid and dropping it gradually on the extract, working it at the same time with the spatula. The uniformly soft mass thus obtained was then easily mixed with a second part of the ointment, forming a perfectly homogeneous green salve.

"As to the tannic acid," said the Proprietor, "it is sometimes necessary to powder it finely in a mortar in order to remove small lumps that are occasionally present. In our case it is a perfect powder, and you can at once take the powdered opium with it, as the two drugs are not incompatible."

The Senior, having profited by former experience, very skilfully handled the fine powder of the two drugs, incorporating only a very little at a time, and turning his spatula slowly and carefully, so that a sudden pressure on the midst of the powder, or even the draft caused by a quick motion, might not blow the powder over the slab and counter.

"The last step is to mix the three parts of our prescription," said the Proprietor, "which can now be done without impairing the qualities of the ingredients. Let me add a word about dispensing salves. Always use a jar with a rounded bottom, so that the buyer can easily remove the last particles, and let there be no projecting shoulder, under which some of the salve might be caught. Paste the label on the body of the glass, and let it not be soiled by fat or oil. If your hands have become greasy in the manipulation, wash them before you write or paste the label, and dispense in this, as in all other cases, only a perfect article."

"I put the bottles on the table," interrupted a voice from the laboratory. These words emanated from the small boy who had just cleaned and drained a number of wide-mouthed, round, two-ounce bottles, commonly called vaseline bottles, which should be filled that day with petrolatum.

The Proprietor returned to the laboratory, where the Junior was already waiting for him, standing near a barrel of the petrolatum extract.

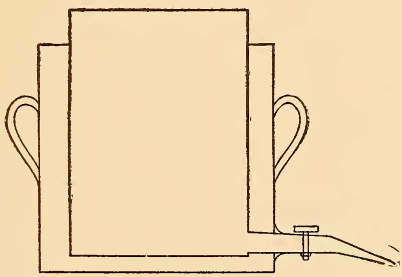
"How shall I fill the bottles?" he asked. "In my former position we used to melt it in an old coffee-pot and pour it out; but I see no coffee-pot around here."

Before giving the proper directions, the Proprietor asked: "Was that a satisfactory way?"

"Well, sometimes; but we had to watch the pot very closely. If the heat became too great, bad-smelling odors would fill the store, and if we turned it off for a while, the petrolatum would get hard again. Sometimes the spout of the pot would get stopped up, or some would be spilled if the pot was not withdrawn very skilfully. So there generally was a good deal of growling and scolding connected with the work, and nobody cared particularly to do it."

"Now all this trouble is avoided by this simple apparatus," said the Proprietor, taking an ointment

Fig. 6.



kettle of peculiar construction from a shelf. "You see there are two tin pails, the one smaller than the other. The smaller is fastened inside of the larger one by brackets, so that there is a space of about an inch all around it,—at the side, as well as at the bottom. An outlet-tube is attached to the lower part of the inner pail, coming out at the side of the outer pail, and ending in a narrow outlet, which can be closed with a stop-cock. The *modus operandi* is simple enough. We put the petrolatum into the inner pail and water in the outer one, forming an ordinary water-bath. By heating the water, the petrolatum will soon melt and can be drawn out of the outlet without disturbing the apparatus. There is no possibility of spilling or burning, as the heat conveyed to the petrolatum can never exceed 212°. In a store where one man has to do all the work, he can safely leave the apparatus without fear of spoiling anything, and when the petrolatum is once liquid, it it will congeal only after a long while, because the surrounding hot water will keep it in that state for a considerable time."

He accompanied his explanation by the actions, and the petrolatum soon liquefied. The gas-stove on which the apparatus stood was high enough to allow the receiving bottles to be placed under the outlet, and the Junior was filling them quickly.

"This takes only one-tenth the trouble and time," he said. "I wonder why other pharmacists do not get a similar kettle."

"The use of this kettle is manifold," said the Proprietor. "If you should wish to fill small tin boxes, instead of bottles, the best plan is to put the apparatus, after the salve has liquefied, on a small block in the middle of the table and the tin boxes around it. Instead of lifting the boxes, which on account of the heat transferred from the salve to the metal can be done only with difficulty, you move the outlet of the kettle from one box to the other, and can thus fill them with the same ease as the bottles."

"Could we not also use this apparatus for other purposes?" asked the Junior.

"Certainly we could," answered his Preceptor. "I use it regularly to make benzoinated lard in, by suspending the benzoin in the lard. However, instead of taking the gum, I pour a corresponding quantity of a concentrated alcoholic solution of benzoin on a number of small, clean pebbles, which I then expose to the sun or artificial heat until the alcohol has evaporated. The benzoin will now adhere in a thin layer to the pebbles, and by suspending them in the lard a cleaner solution is made in a much shorter time than by the official process, on account of the greater surface that the gum presents to the solvent. Simple ointment and simple cerate, as well as many other salves, are also quickly and easily made with the aid of this apparatus, and it also suggested to me an improved method of making zinc salve. Instead of sifting the oxide on melted, benzoinated lard, I rub it in a large mortar until it is very fine, and let the liquefied lard run out of the small orifice of this kettle into the mortar, stirring constantly. This method is less troublesome than the official one, and produces a much finer ointment."

CHAPTER XXIII.

WANT-BOOK — MODIFIED FORMULÆ—ALLIGATION—GRAPHIC REPRESENTATION—DESPONDENT CUSTOMERS.

MEANWHILE, the Manager had looked through the "Want-book," a small memorandum-book that was always hanging at the side of the desk, easily accessible to every operator in the pharmacy, and in which every article that was wanting, or nearly wanting, was entered. Twice a week, on the days when the travelling salesmen of wholesale houses were expected, the Manager compiled his order by consulting this book.

"Our powdered orris root," he addressed the Proprietor, "has become somewhat lumpy. We had better use it for tooth-powder, which is nearly out, and fill our stock bottle with a new lot."

"How much is there of it?" asked the Proprietor.

"About a pound and a half. I have written the formula for the tooth-powder, so as to use all the orris root, and the Junior may prepare it in the course of the day."

The Junior looked at the modified formula and compared it with the original one, saying: "I would like to ask you the question how such calculations are made when a certain quantity or percentage of an article is prescribed in a mixture and we wish to use a different quantity of one of the ingredients. For instance, the other day I added by mistake two hundred cubic centimetres of water to eighteen hundred cubic centimetres of alcohol; and the Manager, whom I asked for advice, said he could use it in making compound tincture of cinchona, for which he needed three thousand seven hundred cubic centimetres of a mixture of alcohol and water in proportion of eight hundred and fifty to seventy-five. I remember these figures, because I tried to figure out for myself how to proceed; but I cannot do it." As he said this, he drew a piece of paper from his pocket, covered with figures, and put it on the counter.

"I can hardly see," said the Proprietor, "where the difficulty should lie; you are required to prepare three thousand seven hundred cubic centimetres of a mixture of eight hundred and fifty parts of alcohol and seventy-five of water. Find, first, how much alcohol this mixture will contain."

The Junior seemed still in doubt, whereupon the Proprietor continued:

"What is the proportion required?"

"Eight hundred and fifty cubic centimetres of alcohol and seventy-five cubic centimetres of water."

"Now, suppose you mix the two quantities; how much does that give?"

"Nine hundred and twenty-five cubic centimetres."

"Very well; how many times must you mix this quantity?"

"Now I see; we divide 3700 by 925, which gives 4. I therefore need four times 850 cubic centimetres, or 3400 cubic centimetres, of alcohol, and four times 75, or 300 cubic centimetres, of water."

"And how much alcohol and water have you in the prepared mixture?"

"Eighteen hundred cubic centimetres of alcohol and two hundred cubic centimetres of water. I therefore add sixteen hundred cubic centimetres of alcohol and one hundred cubic centimetres of water to obtain the desired mixture. I did not think it was so easy."

"This example," continued the Proprietor, "leads us to alligation, a term used in arithmetic to denote the solution of problems involving the mixing of different ingredients of different values or percentages. It is used very largely in manufacturing, and is also applied in pharmacy and chemistry. The principle on which such problems are based is exceedingly simple, and yet there is no other process of arithmetic in which more confusion reigns and more mistakes are made by beginners. All that are needed are a thorough understanding of the principles, and clear, logical reasoning. I cannot in a few minutes go over the whole ground, but I will, by a few practical examples, try to demonstrate the underlying principles to you.

"Let us suppose that we have a quantity of sachet powder, for which we paid nineteen cents an ounce, and some orris root at three cents an ounce; and that we wish to mix the two so that an ounce of the mixture will cost us twelve cents. How much of each must we take? Now, follow my argument. There are two ingredients to be mixed, the one costing less, the other more, than a desired price; therefore, if we sell the expensive article at the desired price, we lose; and if we sell the cheap article at the stated price, we gain. This loss and gain must balance each other in the mixture that we are about to prepare. Thus, we must establish a unit of loss and gain, and figure out how much of each ingredient must be sold to gain or lose this unit. In the problem before us, in which the values are measured by cents, we will call one cent the unit; and the first step of the problem is to determine how much sachet powder we would have to sell at twelve cents an ounce to lose one cent, and how much orris root at the same price to gain one cent? Can you follow me?"

"Yes, sir; very well," said the Junior; "and I believe I can now continue the argument, if you will let me do so."

"Certainly," replied the Proprietor; "try, anyway."

"If I sell an ounce of sachet powder, for which I paid nineteen cents, at twelve cents, I lose seven cents, or I lose one cent by selling one-seventh of an ounce; in the same way, if I sell an ounce of orris root, for which I paid three cents, at twelve cents, I gain nine cents, or I gain one cent by selling one-ninth of an ounce. It is therefore evident, in order to equalize the one cent gained by the one cent lost, that I must sell one-seventh of an ounce of sachet powder to one-ninth of an ounce of orris root."

"That was well said," continued the Proprietor; "and if you will now remember that the figures one-seventh and one-ninth are not the quantities themselves, but only the proportions, you will see that we can change them easily to integers, by multiplying both with the common denominators of the two factions, which is sixty-three, so that we say——"

Here the Junior interrupted him by saying: "63 times $\frac{1}{7}$ is 9, and 63 times $\frac{1}{9}$ is 7; we therefore take nine ounces of sachet powder to seven of orris root."

"Now, let me prove it," said the Proprietor: "nine ounces of sachet powder at nineteen cents an ounce cost one hundred and seventy-one cents, and seven ounces of orris root at three cents cost twenty-one cents; together sixteen ounces at one hundred and ninety-two cents, or one ounce at twelve cents, as required."

"Well, I really do not see any difficulty in this problem, now that you have explained it so clearly to me. I remember when I tried to learn this before, that we had a system of lines by which we connected two figures; and it was these lines that used to puzzle me."

"You mean," said the Proprietor, "a graphic representation of the process, which is, indeed, a help when the number of ingredients is larger than two. Let us suppose, for instance, that we want to prepare tincture of opium, and have four different quantities of powdered opium, which by analysis have yielded respectively five, nine, fifteen, and seventeen per cent. of crystallized morphine. The average strength required by the 'Pharmacopœia' is fourteen per cent.; and in order to figure out our problem, a graphic representation is of great help. We, therefore, draw a perpendicular line, and write to the left of it the required mean percentage, fourteen; and to the right, the different ingredients, commencing with the smaller, five, nine, fifteen, seventeen. Now we draw another line, and write opposite each figure the proportion of the standard opium it would take to gain or lose one per cent.; which will be respectively one-ninth, one-fifth, one, one-third. Multiply these figures by the common denominator, forty-five, and we obtain as the quantities required, five, nine, forty-five, and fifteen ounces or pounds, or whatever common unit of weight we choose to adopt. The proof of correctness is easily shown; thus:

14	5	$\frac{1}{9}$	5	$5 \times 5 = 25$
	9	$\frac{1}{5}$	9	$9 \times 9 = 81$
	15	1	45	$45 \times 15 = 675$
	17	$\frac{1}{3}$	15	$15 \times 17 = 255$
			74 (parts) into	1036 (14
				74
				296
				296

Or 1 part at 14 per cent."

"Is this the only solution?" asked the Junior. "I should think other combinations could be made."

"So they can," replied the Proprietor; "we can always combine two figures, one less than the required mean and one larger. For instance:

14	5	. .	1–9	. .	1	1	1 × 5 = 5
	9	1–5	. .	1	. .	1	1 × 9 = 9
	15	1	. .	5	. .	5	5 × 15 = 75
	17	. .	1–3	. .	3	3	3 × 17 = 51
						10 (parts) at	140

Or 1 part at 14 per cent.

"You see that I connected 5 and 17 by a line, indicating that I wish to consider these two quantities by themselves; and in the same way 9 and 15. The drawing will explain the way of proceeding. Now draw another diagram, combining 5 with 15 and 9 with 17."

The Junior, after some reflection, produced the following:

14	5	$\frac{1}{9}$	. .	1	. .	1	1 × 5 = 5
	9	. .	$\frac{1}{5}$	. .	3	3	3 × 9 = 27
	15	1	. .	9	. .	9	9 × 15 = 135
	17	. .	$\frac{1}{3}$	. .	5	5	5 × 17 = 85
						18 (parts) at	252

Or 1 part at 14 per cent.

"Now notice," continued the Proprietor, "that in comparing the original figures of any couplet, the proportional number finally obtained for either term is the difference between the mean rate and the other term. Thus, in our last diagram, combining 5 and 15, the final proportional number for 5 is 1, being the difference between 15 and the mean, 14; and the proportional number for 15 is 9, being the difference between 14 and 5. In the same way the couplet 9 and 17 shows as final number for 9 the figure 3, being the difference between 17 and 14; and for 17 the figure 5, being the difference between 14 and 9. You might, therefore, write the last column directly after the first one, omitting the intermediate explanatory columns, as is often done."

"That is what we used to do in school," said the Junior; "and we never understood how we got these figures. I believe that is why I could not remember it."

The Proprietor replied: "That is a very natural consequence of substituting the memorizing of a rule for the logical development of the problem."

"Suppose there is an uneven number of figures," said the Junior.

"In that case you must combine one figure with two opposite ones. For instance, we have mixtures of alcohol and water of the following percentages in alcohol: ten, twenty, thirty, eighty, and ninety; and we wish to combine them so as to obtain a fifty-per-cent. mixture. I will draw the diagram."

		1	2	3	4	5	6	7	
	10	$\frac{1}{40}$	. .	. .	3	. .	. .	3	$3 \times 10 = 30$
	20	. .	$\frac{1}{30}$	. .	. .	4	. .	4	$4 \times 20 = 80$
50	30	. .	. .	$\frac{1}{20}$	. .	. .	3	3	$3 \times 30 = 90$
	80	$\frac{1}{30}$	. .	$\frac{1}{30}$	4	. .	2	6	$6 \times 80 = 480$
	90	. .	$\frac{1}{40}$	. .	. .	3	. .	3	$3 \times 90 = 270$
								19 (parts) into	950

Or 1 part at 50 per cent.

"You see that we use the eighty-per-cent. alcohol twice, and we therefore obtain two final proportional figures for it, 4 and 2, which must be added for the final column. A great number of variations can, of course, be made by combining the figures differently, and consequently there will be different answers."

"I think I understand this thoroughly now," said the Junior; "but there is one thing that is not quite plain to me. We obtain here a number of answers different from each other and yet all correct. But suppose we have a certain quantity of an article that we wish to use up, how shall we proceed?"

"Take again a practical illustration," said the Proprietor; "let us suppose we are told to make a mixture of glycerin and water of a specific gravity of 1.15, and we have five hundred cubic centimetres of a mixture of 1.06 specific gravity which we wish to use up, the specific gravity of pure glycerin being 1.25:

1.15	1.06	$\frac{1}{9}$	10	$10 \times 1.06 = 10.60$
	1.25	$\frac{1}{10}$	9	$9 \times 1.25 = 11.25$
			19 (parts) at	21.85
Or 1 part at 1.15.				

"This diagram shows that we must take ten parts of the weaker mixture to nine of glycerin; but we have five hundred cubic centimetres on hand,—that is, fifty times ten parts,—and we must therefore take fifty times nine parts of glycerin. In other words, we mix the five hundred cubic centimetres of glycerin and water of a specific gravity of 1.06 with four hundred and fifty cubic centimetres of pure glycerin and obtain nine hundred and fifty cubic centimetres of a mixture of specific gravity of 1.15. A similar process of arguing is needed if the finished product is to be of a fixed quantity. For instance, we want to prepare five thousand cubic centimetres of tincture of opium, and have on hand three different lots of the drug, containing seven, eight, and sixteen per cent. of morphine, how much must we take of each?"

"Let me try to figure this out," said the Junior. "I believe I can do it. The opium for our tincture must contain an average of fourteen per cent. of morphine; we therefore prepare this diagram :

14	7	. .	$\frac{1}{7}$	. .	2	2	$2 \times 7 = 14$
	8	$\frac{1}{6}$	. .	1	. .	1	$1 \times 8 = 8$
	16	$\frac{1}{2}$	$\frac{1}{2}$	3	7	10	$10 \times 16 = 160$
						13 (parts) at	182

Or 1 part at 14 per cent."

"Now, the proportional numbers added together give thirteen units," continued the Proprietor; "but for our five thousand cubic centimetres of tincture we need five hundred grammes of the drug. Therefore we need as many units as 13 is contained in 500, or 38.462. We must therefore multiply each quantity by 38.462, as follows :

$2 \times 38.462 =$ 76.924 grammes of seven-per-cent opium.
$1 \times 38.462 =$ 38.462 grammes of eight-per-cent. opium.
$10 \times 38.462 =$ 384.620 grammes of sixteen-per-cent. opium.

"Now prove the correctness of these figures," continued the Proprietor.

"That is easily done," said the Junior; "we multiply the quantities with the percentages and add:

$$\begin{array}{rcl} 7 \times 76.924 & = & 538.468 \\ 8 \times 38.462 & = & 307.696 \\ 16 \times \underline{384.620} & = & \underline{6153.920} \\ 500.006 & \text{at} & 7000.084 \text{ per cent.} \end{array}$$

Or 1 part at 14 per cent."

"These examples," said the Proprietor, "will give you an idea of what alligation is and how easily problems of this kind can be solved. There is much more to be said about it, but what we have gone over will be sufficient for your present needs. I see I am wanted in the store."

These last words were spoken on observing the Senior, who had appeared at the entrance, casting a suggestive look at his Preceptor. At the same time a rather loud and excited conversation was heard to take place between the Manager and a customer.

"There is a lunatic in the store," whispered the Senior, half frightened and half amused. "He wants some poison with which to kill himself."

The Proprietor walked leisurely into the store and beheld one of those unfortunate, dejected victims of drink that are but too numerous in large cities.

"There you are, doctor," said the drunkard; "I know you will help me. I am tired of life; I am ashamed to live; I will end this miserable existence. Look at me! What good am I to myself or to anybody else? I've been on a spree for two weeks; my money is gone, my good name——"

Here he stopped suddenly, as if overcome by the recollection of his former better life, and the consciousness of his depravity slightly flushed his face.

"Why don't you regain your good name?" asked the Proprietor.

"Too late, too late, doctor!" replied the drunkard, staggering nearer. "I'll tell you what I want. Give me some poison to end this miserable life; I will take it to-night on going to bed."

"What do you think of me!" said the Proprietor. "If I give the poison to you now, you will show it to everybody and talk about it, and I shall be arrested before you take it. Oh, no, sir!"

"I will tell nobody," said the customer, "upon my honor."

"You might as well affirm, 'Upon my sobriety.' No, sir. You can have no poison."

"Oh, doctor, help me! Don't you see that I am tired of life?"

"Yes, I see; and I think that death is the greatest blessing for you. I am also willing to help you, but not in the way that you state."

"What will you do, doctor?"

"I will give you a drink that will kill you within five minutes; but you must promise to leave this store at once after drinking it, because I do not want to see you die in here. Will you do so?"

"Certainly, doctor, certainly."

"And you are quite sure that you are ready to die?"

"Certainly. I wish nothing else."

"Then wait a few minutes," said the Proprietor. "I will prepare the draught."

He went behind the prescription-counter, where the clerks had gathered and overheard the peculiar conversation. When they saw the serious features of their Preceptor change to smiles as soon as he was out of sight of the would-be suicide, they knew that a joke was intended, and could hardly refrain from laughing.

"I expect he will run out now," whispered the Proprietor; and the deep sighs that came from the store indicated that the drunkard was arguing with himself about the events of the next five minutes. After a while the Proprietor took a small graduate, filled it with water, and added a few drops of compound tincture of cardamom to impart color and taste to the "deadly" drink. "I must scare him a little more before I get rid of him," he said to his clerks, and returned with the graduate to the store.

"Now, sir," he said, "here I have your poison. Drink it all, and run out; in five minutes you will be relieved forever."

The drunkard looked at the glass before him. Slowly his trembling hand was raised, but it dropped again.

"No mistake about the drink killing me?" he asked, less determined than before.

"None at all. Go on, now."

The unfortunate fellow took the glass and lifted it to his nose.

"In five minutes?" he said, doubtfully.

"In five minutes. You will have no time to change your dress."

"No time to change my dress," mused the other, "nor to take another drink."

"Nor to reform," thundered the Proprietor, impressively. "You will go to hell as you are."

This sudden turn seemed to strike the suicide like a flash of lightning; his eyes opened wide, and in consternation he gazed at the speaker. Then, as if following a sudden inspiration, he exclaimed, in a tone of earnest determination: "No, sir; no, sir;" and, putting down the glass without having drunk a drop of the contents, quickly walked out of the door, followed by the loud laughter of the clerks, who could no longer restrain themselves.

CHAPTER XXIV.

PLASTER-MAKING—OFFICIAL PLASTERS—AN OLD ACQUAINTANCE—NON-SECRETS—PASSED EXAMINATIONS—STARTING IN BUSINESS—BROADER VIEWS—CHARACTER.

"An order of this kind is a 'rarity,' said the Proprietor one morning, showing his clerks a prescription that a customer had just handed him. "I remember the time when plaster-making was our daily occupation, but I would like to know how many pharmacists are able or would care to make any to-day?"

The prescription in question read:

Cantharidis, ʒss;
Camphor, ʒi;
Ceræ flavæ, ʒi;
Piscis Burgund., ℥i;
Ol. Olivæ, ʒi
M. et ft. emplast. 6 x 10.
Spread on skin.

"What shall we do with it?"

The clerks looked at the prescription, and after awhile the Senior suggested:

"The camphor must be powdered and mixed with the cantharidis; there can be no question about that. The other ingredients appear to me to be Burgundy Pitch Plaster."

"You are nearly right," said the Proprietor; "a difference, however, exists in the quantities of wax and olive oil, which in the official plaster are in the proportion of one to three, while here we have equal parts. We must, therefore, melt the ingredients and, while liquid, incorporate with them the mixed powder."

"This is the first time in my experience," said the Senior, "that I have seen a plaster made in a pharmacy."

The Proprietor took from a closet an apparatus which he called his plaster-pot, consisting of a round, iron pot, surrounded by a water-bath, resembling the glue-kettle that carpenters use, with the difference that the inner pot was provided with an iron, wood-covered handle.

"In former years," he said, "I have prepared many plasters in this pot, which now must be cleaned of dust and spider-webs, in order to make it fit to be used,—a clear illustration, again, of how the large manufacturers have superseded some of the handicraft of the pharmacist. Weigh the ingredients."

While the Senior weighed the articles for the plaster and put them into the inner pot, after preparing the water-bath, the Junior powdered the camphor and mixed with it the cantharidis.

"In preparing this plaster-body," said the Proprietor, "we follow the same directions laid down in the 'Pharmacopœia' for Burgundy Pitch Plaster, melting the solids and then incorporating the olive oil with constant stirring. This plaster enters into some other official plasters, namely, Emplastrum Picis Cantharidatum, or warming plaster, being greatly rubefacient, resembling our prescription, which, however, also contains camphor. The Burgundy Pitch Plaster is also used in iron plaster, Emplastrum Ferri. A more important plaster-base, used in most other plasters, is the lead plaster, Emplastrum Plumbi."

"I know how it is made," interrupted the Senior: "oxide of lead, olive oil, and water are boiled together."

"So it is," answered the Proprietor. "There were various theories about the chemical process going on in such a mixture, but the latest researches show that saponification takes place, and the plaster might be called a lead-oleo-palmitate, or, if stearin be present in the olive oil, a lead-oleo-stearo-palmitate.

"By mixing lead plaster with resin and yellow wax, the Resin Plaster, or common adhesive plaster, is formed, which comes spread on muslin. It is the best-known plaster, and enters again into a number of other official plasters.

"Let us now proceed with our prescription," continued the Proprietor, pouring a dram of olive oil into the molten pitch and wax and stirring with a glass rod.

"No further heat is needed," he added, turning off the gas. "How will we get the camphor and cantharidis into the plaster?"

"Why, just put it in and stir," suggested the Senior.

"A better way, to avoid lumping, is to sift it into this mass. A large sieve is, of course, out of the question; but my little prescription-sieve, that you know already, answers the purpose admirably by taking off the lower receptacle, allowing the sifted powder to drop into the plaster-pot."

By using the prescription-sieve the camphor and cantharidis were soon incorporated in the plaster, and the Junior, who was stirring the mixture with a glass rod, looked inquiringly at his Preceptor for further instructions.

"Lift the pot out of the water-bath," said the latter, "so that the mass may harden the more quickly. We will meanwhile prepare the skin. We need a piece six by ten inches. How can we best spread the plaster?" And when no one answered, he continued: "There are various contrivances for this purpose, which it would take too long to explain; nor does such a detailed explanation seem necessary, as plaster-making is now hardly ever required of the pharmacist. The simplest and most easily improvised method consists in cutting strips of thin pasteboard of a length a little greater than required,—that is, two pieces of eight inches and two of about twelve inches each. Now lay the skin on the counter, tacking it down with some thumb-tacks, and on it put the four strips of pasteboard so that they form a rectangle of the size of six by ten inches, holding them in position again by four thumb-tacks."

In speaking, he accompanied his explanations by the deed, and, taking the plaster-pot, continued: "In this rectangle we now pour the molten plaster before it congeals entirely, and with a warmed spatula spread it evenly over the surface. When it becomes hard, we remove the strips of pasteboard and cut the skin off, leaving a border of about half an inch all around. I will now leave this work for you to finish, as I am wanted in the store."

He followed the Manager, who had handed him the card of a visitor, by whose name he remembered an old business acquaintance.

"I am glad to see you, sir," he accosted him, shaking hands with him warmly. "I believe it is almost ten years since we met last. I have often thought of you, but have never found time to hunt you up."

"This is the best greeting that I have received for a long time," replied the visitor; "a drummer is generally not addressed so cordially."

"A drummer?" exclaimed the Proprietor in surprise.

"Yes; an ordinary drummer! My business ventures were not successful—but I will speak about these things at a more opportune hour. Let us rather come to the object of my visit, for I know your way and the value of your time. I am travelling for a manufacturer of Non-secret Preparations, and have an excellent line of samples with me, elegant and neat in appearance, quick and reliable in their action, moderate and reasonable in price." While he spoke, he opened his satchel and displayed a long array of the various so-called Non-secrets before the astonished Proprietor.

There were Sarsaparillas, Liver and Kidney Cures, Expectorants, Alteratives, Liniments, Salves, and Pills, nearly all of them ingenious imitations of similar proprietary goods of wide repute.

"Can you find a better selection?" he continued; "the formula is printed on every package, together with a list of the various ailments that each preparation will cure. We also print your own name on every wrapper, in lots of three dozen, and relieve you thereby of all the trouble of devising formulæ and labels, not to speak of the trouble to which it would put you to prepare them yourself."

All this was done quickly and dexterously, before the Proprietor had recovered from his surprise. Finally he exclaimed:

"And all this from the friend who once fought side by side with me the battles against this new octopus that throttles pharmacy?"

The visitor stopped, and it was now his turn to be surprised. His friend's words recalled the time, now long past, when they both had attended the meetings of State and National Associations, and, with the fire of youthful enthusiasts, argued against the introduction and approval of the very goods that he was now trying to sell.

"I know! I know!" he exclaimed, with a forlorn smile; "lovely days they were, and pleasant remembrances come from them. But those were theories; in practice we must howl with the wolves. Why, my friend, you do not mean to say that you really prepare your own family remedies when you can buy them better and cheaper?"

"I mean to say," replied the Proprietor, with great earnestness, "that I always practise what I preach. When I argue a question before my pharmaceutical brethren, I do so because my heart is full of the subject, and my enthusiasm is as honest as my words are true. I have always condemned the 'non-secret' remedy as fighting the devil with fire. If it is admitted that ready-made remedies must be kept,—and it is at present impossible to free the profession from this necessary evil,—then the pharmacist should prepare them himself. His professional pride must prompt him not to trust to others what he can do himself; his honesty demands it of him,—for how can he pretend to know the ingredients unless he puts them in the mixture himself,—and, finally, his own interest will guide him, for the price that he would pay you for half a gross of your 'non-secrets' is sufficient to buy the whole outfit of boxes and labels that he needs for a full line. I am sorry to disappoint you, but I cannot sacrifice my cherished principle to the pleasure of seeing an old friend again."

Ashamed and disappointed, the travelling salesman removed his samples from the counter, and the conversation drifted to the general state of business and the many difficulties that beset the honest pharmacist in his calling.

Soon after the departure of the travelling salesman the Senior approached the Proprietor, and, his eyes sparkling with joy and excitement, exclaimed:

"I am through! I have just received word that I have passed the College, as well as the Board."

"My hearty congratulations!" replied the Proprietor, shaking his hand warmly. "So you are a full-fledged, registered pharmacist! I know that you have honestly worked for it, and never doubted that you would succeed."

"I owe my success more to your good instructions than my own work," modestly said the young man. "Without your help I would never have learned what I know."

"And what do you intend to do now?" asked the Proprietor.

"That is a question that I was going to ask you. Your advice shall decide which of two plans I shall adopt."

"You might open an opposition store, with cut prices, in the next block," said the Proprietor, jokingly.

"I know better than that," replied the young man. "I am still in doubt whether I should go into business at all or not. A friend of mine has a chance to buy an old-established store, whose owner wishes to retire from business. He proposed a partnership to me, although we both together have only half as much money as the business will cost. What do you think of it?"

"And what is your other plan?" asked the Proprietor.

"Going West. I have spent all my life in this city, and have naturally a desire to see more of the country. However, the good chance that my friend offered me——"

"Go West!" interrupted the Proprietor, emphatically. "See the world and move among other people than those that you have known and who have known you since your childhood. It is a common error of young men to rush into the ownership of a store as the panacea of all pharmaceutical evils. They argue that independence will relieve them from the tedious, long hours, from the comparatively small remuneration, and the arduous work of our profession. Too late they discover that their cares and worries have only then begun, that the new independence is accompanied by new duties and responsibilities, which will not only occupy their mind during the day, but also steal into the rest of the night. But there is a still mightier reason why you should not now bind yourself to a permanent duty. See the world! Learn what lies and lives beyond the narrow circle in which you have moved so far. You have until to-day devoted all your energies to the acquisition of the deftness, skill, and knowledge necessary in the proper execution of your profession. Your family and friends have guided you; now break loose from these ties and depend on yourself; meet other men, see other cities and States, where different conditions of life and different customs prevail; fight your way through adverse influences and adapt yourself to other surroundings. What do you know of your country and its institutions? You hear and read of its size, its wealth, and its resources. Go and see it! Let the vastness of its plains, the grandeur of its mountains, the fertility of its valleys, the inexhaustible supply of its mines, form an impression on your youthful mind. Travel through them all; watch and observe. Meet with disappointments, endure hardships if necessary, and in the struggle for existence and supremacy learn to discern good from evil, right from wrong. If, then, after four or five years you will return home, ready to settle down, your horizon will not be bounded by the four walls of your store, as is so often the case with pharmacists; you will take a broader, more liberal view of your profession, and your actions, your methods, your success, will show this enlargement of your mind. You will then recognize the high value of intercourse with your brother pharmacists; you will enjoy the entertainment contained in a lively correspondence with men of learning and experience; you will consider it not only a pleasure, but a duty to attend State and National Pharmaceutical Associations; you will be interested in their discussions and partake in their arguments. Your voice will be a welcome sound to others of broad views, your words will be listened to with attention and respect, and you will in time gain a place among the prominent men in your profession.

"Thus, these years will not only be the most useful and fruitful time of your life, but they will also give you that foundation of all success, that invaluable possession necessary to respected man and citizen, and particularly indispensable in our profession,—a character."

THE END.